Madras City Water Supply

LAYING THE FOUNDATION STONE FOR THE RAPID GRAVITY MECHANICAL FILTERS

By

Dr. Rajendra Prasad

President of India

on

14th November 1955

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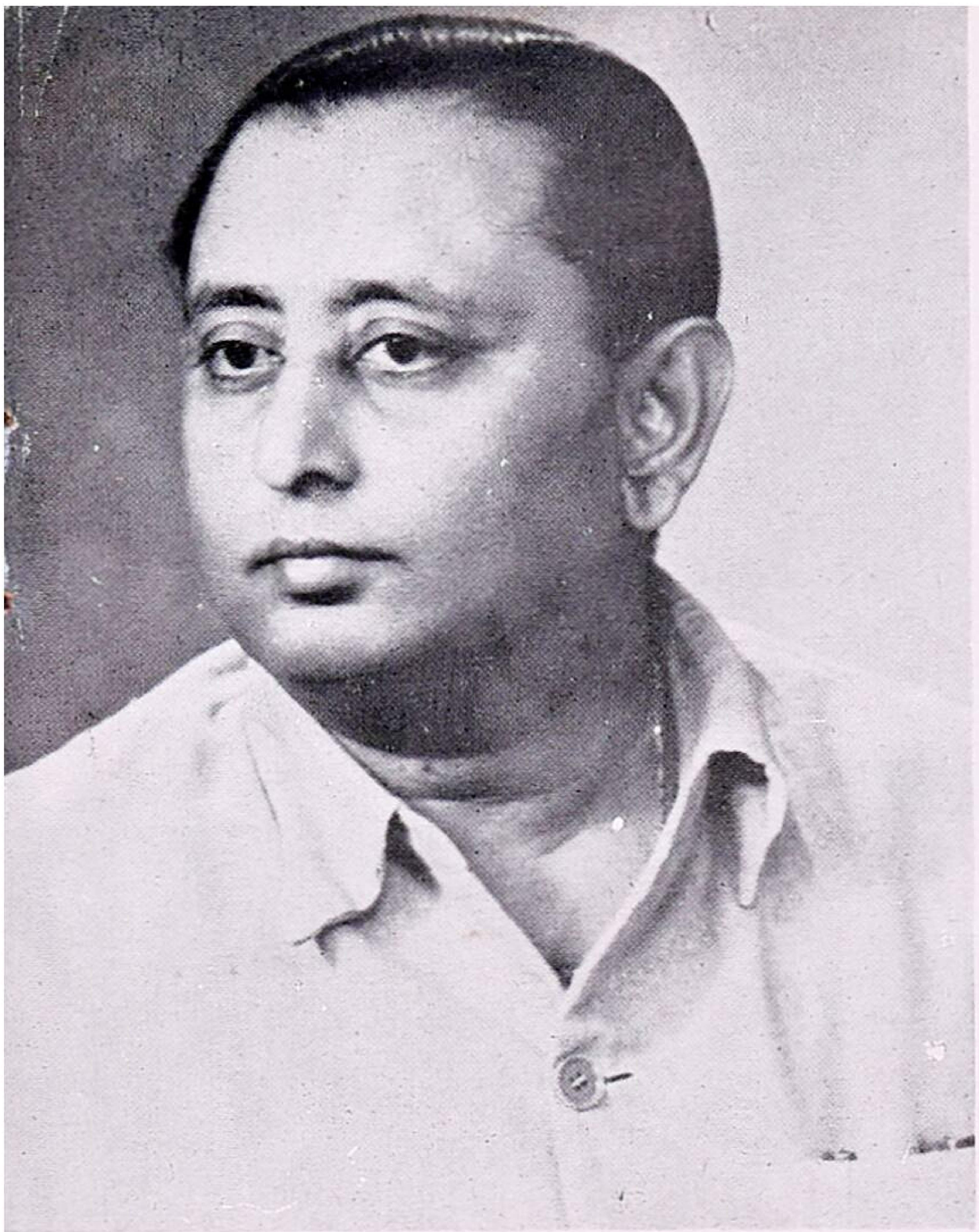

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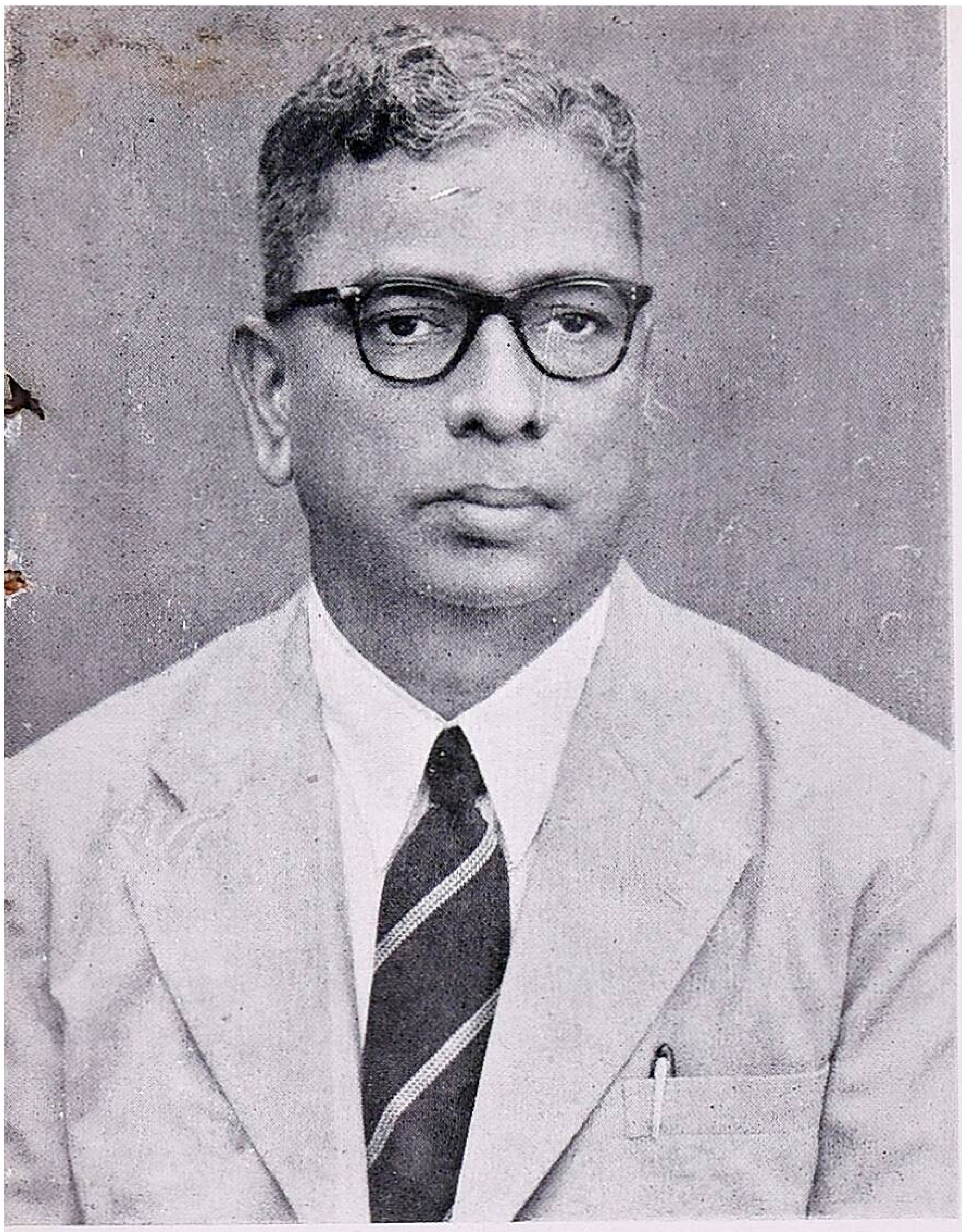

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FOREWORD

AT the time of the opening of the Second conduit by His Excellency Commodore Maharaja Raol Shri Sir Krishna Kumarsinhji Bhavsinhji on the 26th October 1949 a booklet was prepared giving a brief and up-to-date account of the water supply system in the city and the various improvement schemes which were in progress or under contemplation at that time. It is but appropriate that on this occasion of the laying of the foundation stone for the Rapid Mechanical filters by the President of India, a similar brochure is published giving the history of the city water supply, the circumstances that led to the installation of Rapid Mechanical Filters at the Water Works and the various improvement works that are taken up or are going to be taken up hereafter in the I and II Five-year plans.

Madras city water supply dates from the year 1870. The water supply was only a gravity supply without any pumps or filtration. It was only in 1914 that slow sand filters were introduced for the first time and steam pumps and an overhead tank installed to give adequate pressure to the distribution system. Water supply to the city has been inadequate in many respects and the Corporation has been doing its best to bring the supply to this premier city of Madras to a satisfactory condition. The construction of the Satyamurthi Sagar at Poondi which was opened in 1944 was the first of the series of improvements undertaken by the Corporation. Next came the construction of the 2nd conduit which now enables the Corporation to bring an additional quantity of 32 million gallons per day to the city's water works over the 23 million gallons coming through the first conduit. Though certain improvements have been carried out, viz., installing additional pumps, increasing the capacity of the pumping main and laying a separate trunk main for one portion of the city whose water supply was very inadequate, improvements to the filters at the Water Works were not taken up for a long time, though it was long overdue. The Red Hills water does not lend itself to purification by simple methods owing to the fact that the water in the lake is highly impregnated with organic matter in suspension and in solution during certain parts of the year. The slow sand filters installed in 1914 were soon found to be quite unsuitable for dealing with this water. From that time onwards, various experiments were conducted by the Government-constituted Committees and it was finally decided that the treatment of water should be by coagulation followed by rapid sand filtration. A scheme was drawn up for installing rapid

mechanical filters of 32 million gallons per day capacity at the Kilpauk Water Works, but this was not sanctioned for a long time owing to various reasons. Finally, Government approved of the proposal of the Corporation to instal Rapid Mechanical Filters of 10 million gallons per day capacity in the first instance. Soon after the completion of this work, it is hoped that further sanction would be accorded for the installation of Rapid Mechanical Filters for yet another 30 million gallons so that the whole of the city water supply could be treated properly.

Plans and estimates for the installation of Rapid Mechanical Filters of 10 million gallons capacity amounting to Rs. 25.00 lakhs were sanctioned by the Council on 9—4—1951 and by Government in G.O. No. 3019-H, dated 8—11—1954. Government were also pleased to state that the scheme will be financed half as loan and half as free grant. Tenders were invited for the installation of these filters and the work is going to be let out on contract very soon.

Apart from the various schemes included in the I and II Five-year plans and dealt with in the brochure, there is one important factor which deserves consideration. The source of water supply has never been satisfactory in terms of quantity, especially as all the sources nearby the city are dependent on the north-east monsoon whose vagaries are only too well known. Before the separation of the Andhra State, the Madras Government took up the investigation of the Krishna-Pennar scheme for bringing water from the River Krishna down to the south. Investigation of this scheme was later given up. Now that the Planning Commission has decided to have the Nandikonda Project it is hoped that the Andhra Government would be able to spare the water required for the city from this source.

M. A. CHIDAMBARAM,
Mayor.

INTRODUCTION

On this occasion of the laying of the foundation stone for the Rapid Mechanical Filters at the Kilpauk Water Works by Dr. Rajendra Prasad, President of India, it is considered that a brochure giving the history of the City's water supply with an account of the various improvement works that have been taken up by the Corporation may be published, so that the public may have full details of what the Corporation has been doing for the improvement of the City's water supply from time to time.

The brochure gives a history of the water supply system of the City, the details of several schemes which have so far been carried out and particulars about the schemes that are to be carried out in the first and the second 5-year plans. It will be observed that the capital cost so far incurred by the city water supply system is Rs. 317 lakhs but as a good part of this work was done several years ago when the cost of works was very much lower, the present value of the water supply system of the city is much more than the amount actually spent on it. The cost of the schemes now in execution and the schemes yet to be taken up under the second 5-year plan was estimated by the Corporation to be Rs. 442.00 lakhs but after some pruning by the State Government, it is now expected to be Rs. 283 lakhs. This does not provide for any new sources for augmenting the quantity of water supplied to the city and the cost of any scheme for this purpose is likely to be anything between Rs. 1 to Rs. 3 crores, depending upon the source which may be eventually decided upon.

Thanks to the continued help and assistance from the State Government by way of loans and grants, it has been possible for the Corporation to carry out various schemes of large magnitude. With the installation of the Rapid Mechanical Filters the foundation stone for which is now being laid by our revered President, the difficulty in purifying the water will be solved to some extent and after the installation of mechanical filters for another 30 million gallons, which is expected to be taken up soon after the completion of this work, the water supply to the City would be placed on a basis which will give entire satisfaction to the City and the Corporation as far as the quality of the water is concerned. Schemes for improving the distribution system as well as obtaining as much of the water from Kortalayar as possible and as early as possible are being worked out and it is hoped that with the assistance of the State and the Union Governments it will be possible to improve the water supply system of the city to a substantial extent before the end of the period of the second 5-year plan.

V. N. SUBBARAYAN,
Commissioner.

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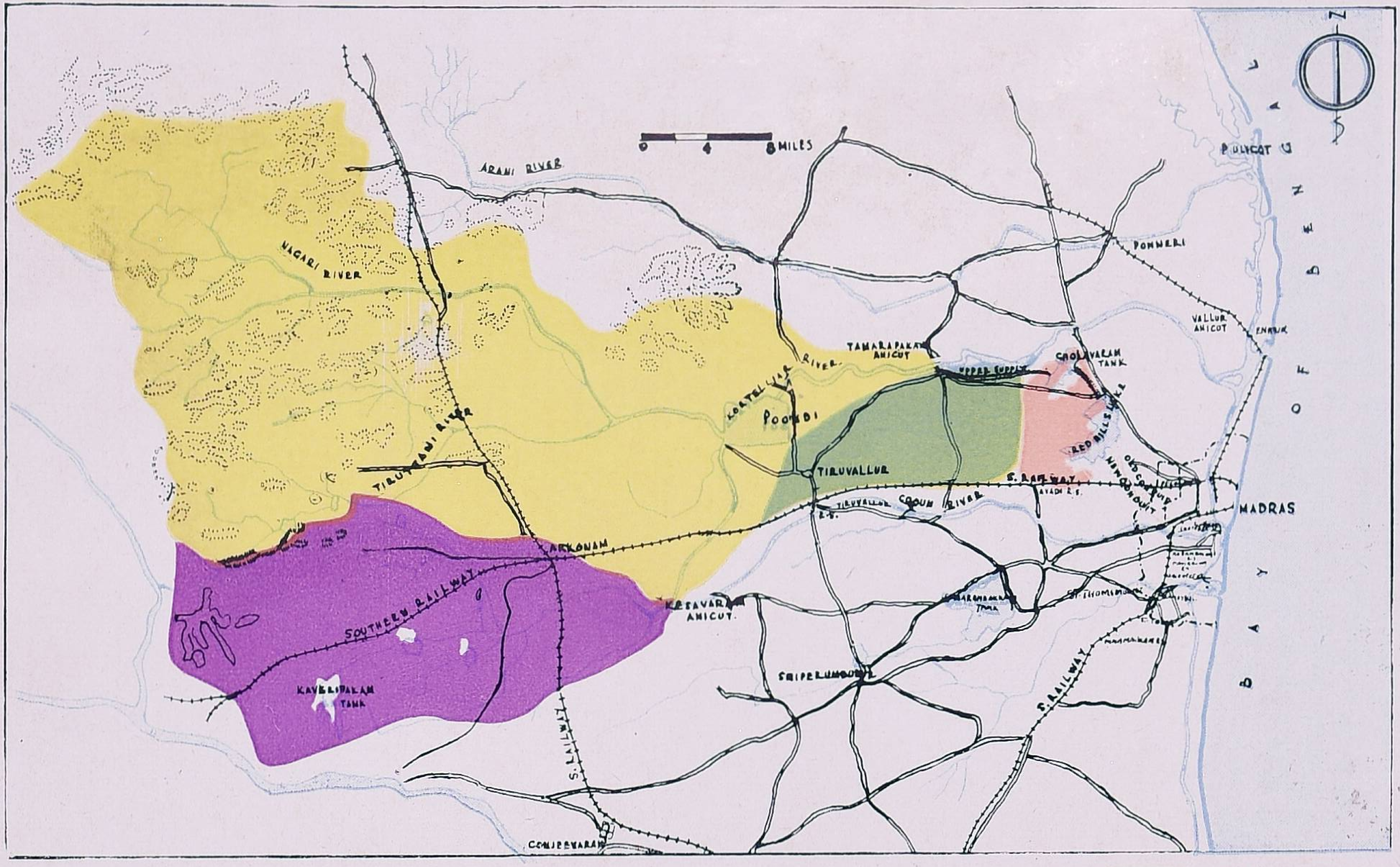
MADRAS WATER SUPPLY SYSTEM

AND CATCHMENT AREAS FROM WHICH RED HILLS LAKE IS SUPPLIED



Area Draining to River Kortalayar above Tamarappakkam Anicut coloured Yellow thus		837 sq. miles.
Area Draining to Rivers Katankal and Boosikal which deliver into Channel supplying Cholavaram Tank coloured Green thus		106 sq. miles.
Area Draining direct to Cholavaram and Red Hills Tanks coloured Red thus...		34 sq. miles.
Area Draining to River Kortalayar but diverted to River Cooum coloured Violet thus		268 sq. miles.

MADRAS CITY WATER SUPPLY

TILL about 1870, there was no protected water supply to the city of Madras. People in the city depended for their water supply on shallow wells situated in their own houses or on public wells and tanks in the neighbourhood. These sources were not satisfactory as they were subject to serious pollution owing to the porous nature of the subsoil and want of proper drainage.

The possibilities of providing a system of protected water-supply to the city were explored and various proposals were made, from time to time and considered. Finally the Government adopted the proposal of Mr. Fraser, C.E., to tap the Kortalayar river and its tributaries Kattangal and Busikal. The Kortalayar river takes its origin from the Nagari Hills on the Eastern Ghats about 100 miles north-west of Madras. The river is usually in full floods 3 or 4 times during the North-east Monsoon period from 15th October to 30th November when Madras receives about 30 inches of rain out of a total average annual rainfall of 45 inches. Normally all the water required for the city supply has to be stored during this period. This is effected by means of a masonry weir 6 ft. high built across the Kortalayar river at Tamarappakkam about 17 miles North-west of Madras. This weir diverts the river water—excluding the greater flood discharges—into a channel known as the Upper Supply Channel about 8 miles long which feeds the Cholavaram Tank which in turn is connected to the Red Hills Tank by another Channel 2½ miles long known as the Lower Supply Channel. These two tanks store the flood water resulting from the monsoon rains and make it available during the months the river bed is dry. Both these tanks receive a considerable supply of water from their own catchment area of nearly 140 sq. miles. The Madras water supply is drawn from the lower of the two tanks (viz) the Red Hills Tank.

These works connected with the diversion of the water from the Kortalayar river into the Cholavaram and Red Hills Tanks were undertaken by the Government as a combined water supply and Irrigation Project and completed in 1870 at a cost of Rs. 18.50 lakhs. When the Government took up this scheme for execution, they offered to take the Corporation as the joint owners of the scheme with the Government, if the Corporation was prepared to meet about 50 per cent of the cost of the scheme but the Corporation did not accept the suggestion. Instead the Corporation elected to be treated as a mere consumer. The cost of the works was therefore entirely met by the Provincial and Central Governments

and their maintenance is in the hands of the Government Public Works Department.

The works required to convey the water from Red Hills to Madras were constructed solely by the Corporation who also maintain them. These works, which were inaugurated in 1872, comprised a valve house situated at the South-east corner of the Red Hills tank and an earth supply channel about 7 miles long to convey the water to Madras city by gravitation. At the Madras end, the Channel delivered the water into a masonry shaft at Kilpauk from which the cast iron mains of the city distribution system took off.

This system of supply had several faults.

Faults of the old system.

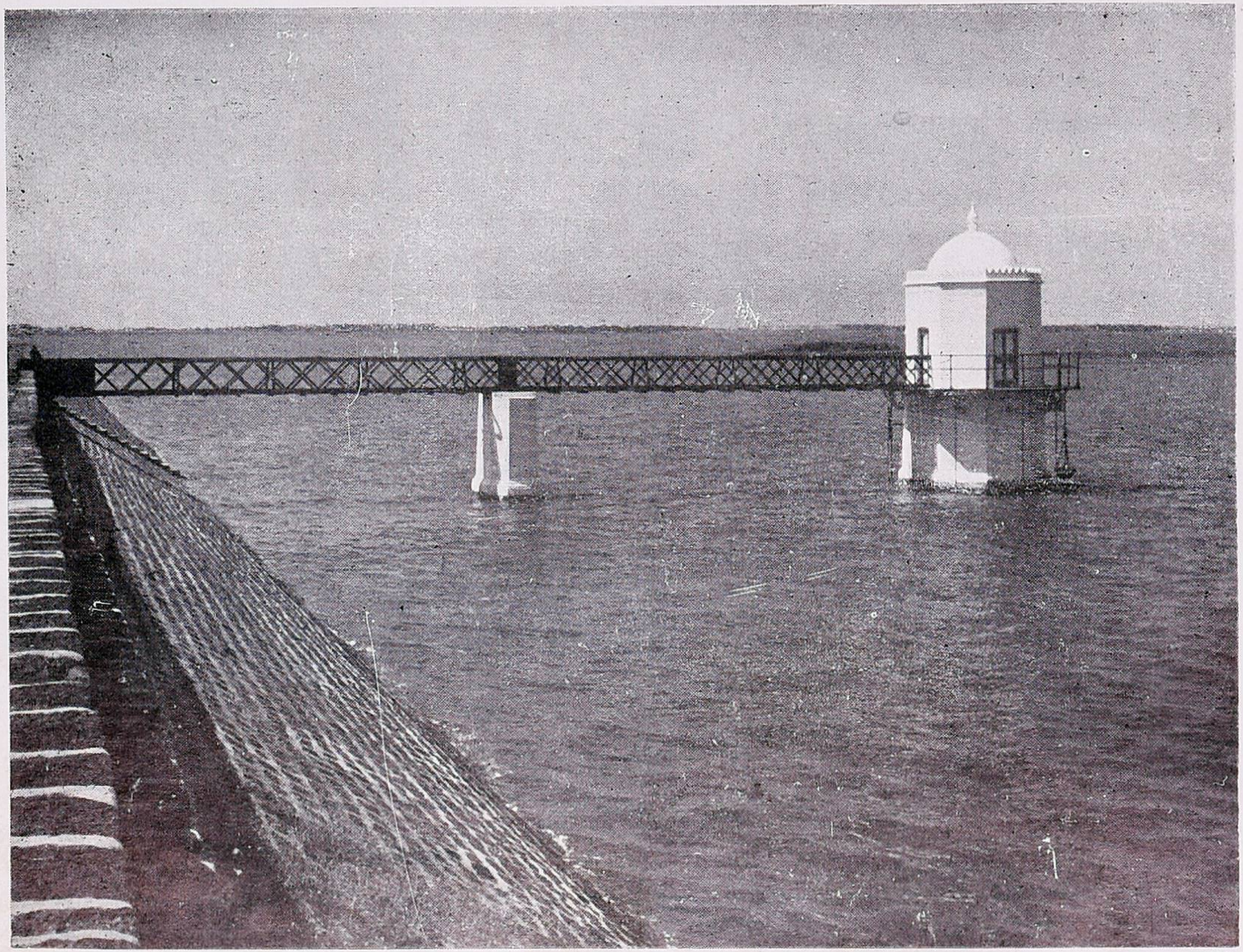
1. The lake was tapped at so high a level that a considerable quantity of water in the Red Hills Lake remained below the draw off level and pumping had to be resorted to deliver the water into the channel. Whenever such pumping was resorted to, the water so supplied was full of sediment and impurities and resulted in high death rate in the city due to Cholera and other bowel complaints.
2. Serious loss of water occurred in transit besides contamination en route.
3. The channel could not carry enough water to meet the growing needs of the city.
4. There was constant danger of the breach of the channel sides.
5. There were no filters or other means of purifying the water.
6. The distribution system was not capable of supplying water to consumers either sufficient in quantity or adequate in pressure.

This system of supply, however continued till about 1914 when several major improvements were effected to the water supply system of the city according to Mr. Madeley's Scheme.

Mr. Madeley's Scheme inaugurated in 1914.

This comprised the following :

1. An In-take Tower in the Red Hills Lake located at the deepest point in the lake, so that the lake can be almost



RED HILLS LAKE.—Showing the expanse of water and the Intake Tower.

entirely emptied without pumping. (Advantage was taken of a breach that occurred in Red Hills Lake in 1881 and the In-take Tower was actually constructed at that time).

2. A covered underground masonry conduit in place of the open earth channel.
3. Slow sand filters to purify the water.
4. Pure water tanks to store the filtered water.
5. Pumps to impart an adequate pressure to the water.
6. An elevated tank to ensure the maintenance of a steady pressure in the mains.
7. The remodelling, alteration and extension of the distribution system so as to provide all the inhabitants of Madras with an adequate quantity of water under sufficient pressure.

Subsequent improvements.

Since then various other improvements have been carried out from time to time to augment the source of supply and to ensure a better and more equitable distribution of water to meet the growing needs of the city which has developed far more rapidly than was anticipated in 1914 at the time of the inauguration of Mr. Madeley's Scheme. The most notable amongst these are the following :

1. Construction of a dam across the River Kortalayar and forming the reservoir known as Satyamurthi Sagar at Poondi 12 miles above Tamarappakkam Anicut to impound the water and let it down the river without surplussing over the Anicut.
2. Construction of a 2nd Conduit to carry more water from Red Hills to Kilpauk and to provide facilities for cleaning the conduit.
3. The installation of 3 electrical pumping units at Kilpauk in addition to the 3 Steam Engines.
4. Duplication of the 48 inches Pumping Main from the Kilpauk Pumping Station to the Shaft.
5. A separate 42 inches Trunk Main to serve South Madras.

While these improvements have gone a long way to meet the needs of the city in regard to water supply, the Corporation has still to carry out a number of important water supply schemes

and find a perennial source of supply before it can claim to have satisfactorily solved the problem of water supply to this large and growing city.

Brief description of the existing works.

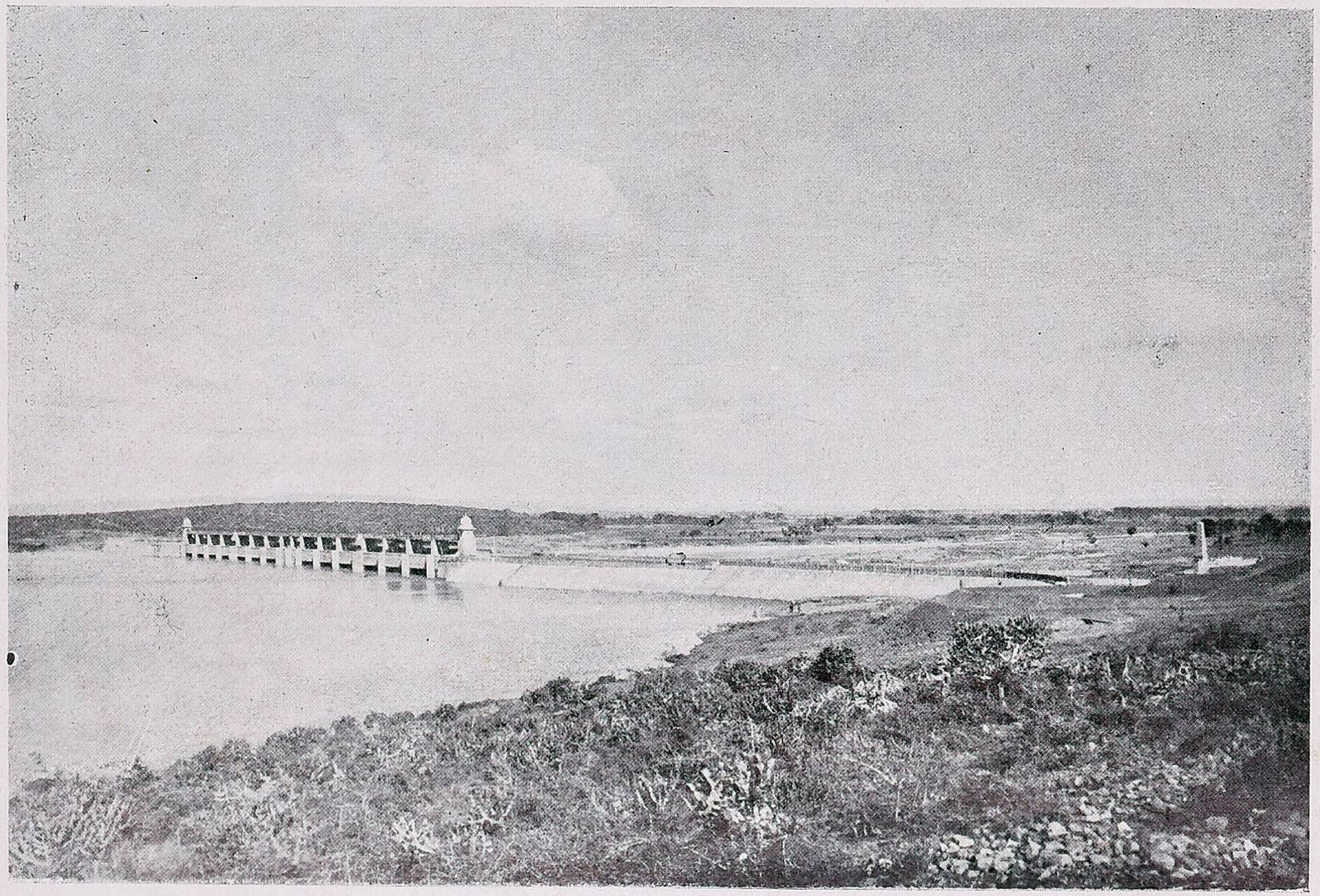
As stated already the Water Supply to the City of Madras is drawn directly from the Red Hills Lake through an In-take Tower known as the " JONES TOWER ", located at the deepest point in the lake. The water drawn through the In-take Tower passes through a masonry Tunnel and enters a screening chamber and roughing filters at Red Hills where the grosser impurities are removed by passing the water through a gravel bund. The water then flows by gravity through two masonry arched underground Conduits 7½ miles long and enters the Kilpauk Water Works where it is filtered, chlorinated and pumped into the City Distribution System. All these works were carried out by the Corporation of Madras and are maintained by them.

Red Hills Lake.

This lake is situated about 8 miles to the North-west of Madras on the Great Northern Trunk Road. The water from this lake and the Cholavaram Lake further north is also used to irrigate about 7,500 acres of wet lands. The total quantity of water issued from the Red Hills Lake for the City Supply in a normal year will be about 8,750 million gallons or 1,400 million cubic feet. The quantity of water used for irrigation will be about 340 million cubic feet per annum. The total estimated quantity lost by evaporation in the two lakes is about 1,100 million cubic feet per annum. The Corporation pays to the Government for all water drawn from the Red Hills Lake for the City Supply at Re. 1 per 1,000 cubic yards, subject to a maximum payment of Rs. 55,000 per annum, the quantity of water drawn being measured by a Weir recording apparatus installed at the Roughing Filters at Red Hills.

Satyamurthi Sagar.

On account of the developments that have taken place in the City during the last 50 years, and the large increase in the City population, the Corporation began to feel by about 1936, the urgent need for an additional source of water supply for the City. The storage at Red Hills was found only just sufficient to meet the requirements of the City for one year and the failure of the North-east Monsoon in 1938, placed Madras in desperate straits. To meet the increased demand for water for the growing needs of the City, it was found necessary to augment the source of supply.



SATYAMURTHI SAGAR

After investigating various possibilities, it was finally decided in 1940 to construct a Dam across the Kortalayar River and form a Reservoir at Poondi 12 miles above the Tamarappakkam Anicut. This Reservoir is meant to impound the flood water which normally surplussed over the Tamarappakkam Anicut and discharged into the Sea. Its storage capacity is nearly equal to the combined storage capacity of the Cholavaram and Red Hills Lakes. At the full Reservoir level of 137.5 feet above mean Sea level, the storage in the Satyamurthi Sagar is 2,500 Million Cubic feet.

The construction of the POONDI RESERVOIR was inaugurated in August 1940 and completed in June 1944 by the Government Public Works Department. The Reservoir was formally opened by H.E. the Hon'ble Sir Arthur Hope, G.C.I.E., M.C., Governor of Madras on 14th June 1944. The cost of the works came to Rs. 65.36 lakhs, which was met by the Corporation by taking loans from the Government to the extent of Rs. 39.66 lakhs, the remaining Rs. 25.70 lakhs having been paid to the Corporation as a free grant by the Government. The maintenance of the Reservoir is in the hands of the Public Works Department, the cost thereof being entirely borne by the Corporation every year.

The water impounded at the Poondi Reservoir is drawn into the Red Hills Lake through the Kortalayar River upto Tamarappakkam Anicut and from there through the Upper and Lower Supply Channels. The additional storage of water thus made available at Poondi has helped to a great extent in averting the threatened water famine in the City due to the successive failures of the North-east Monsoon for five years from 1947 to 1951.

The Poondi Reservoir has subsequently been renamed as " SATYAMURTHI SAGAR " as per Council Resolution, dated 20th January 1948, and Government order No. Ms. 1907, P.H., dated 28th May 1948. ' Satyamurthi Sagar ' is situated at a distance of 37 miles to the North-west of Madras.

Storage capacity of the Red Hills Lake, Cholavaram Lake and Satyamurthi Sagar.

		Total capacity in m.c.ft. at F.T.L.	*Actual storage above the sill levels.*
1. Red Hills Lake	...	2,440	1,980
2. Cholavaram Lake	...	583	526
3. Satyamurthi Sagar	...	2,573	2,573

Conduits.

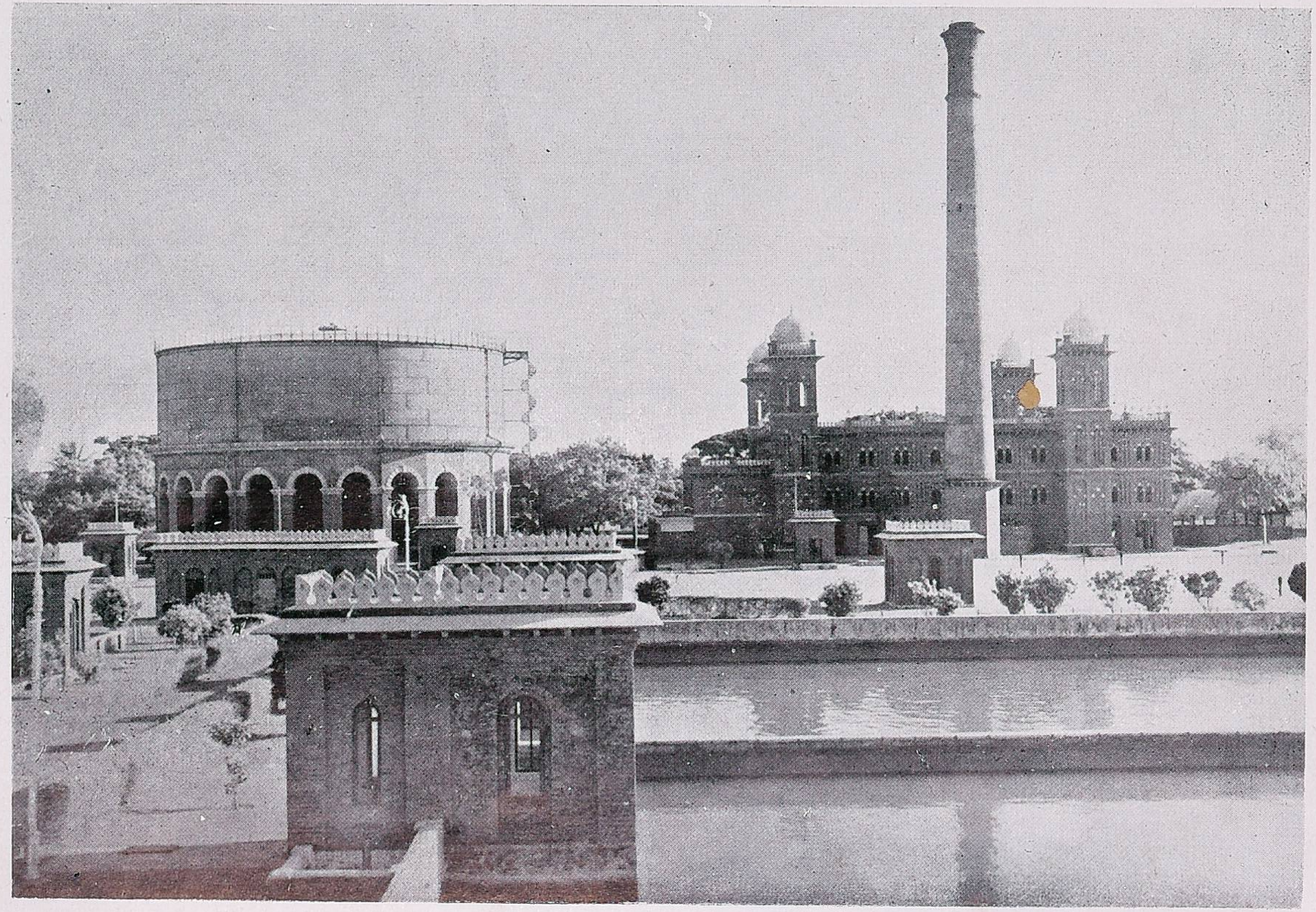
The Water Supply to the City is drawn directly from the Red Hills Lake by means of two covered masonry conduits. The first of these was constructed and opened in 1914. The alignment of the conduit was contiguous to the open water supply channel for its entire length from Red Hills to Kilpauk. The conduit is rectangular in shape 5 feet wide with vertical side walls 4 feet high to the springing of the arched roof which has a height of 18 inches. The floor is inverted with a dip in the centre of 3 inches so that the maximum height is 5 feet 9 inches. The flow is gravitational with an average gradient of 1 in 4470.

The conduit is provided with Manholes fitted with Air inlets or outlets alternately at about every furlong. Two villages en route viz. Surapattu and Madanankuppam which were originally enjoying water supply from the Red Hills Lake are provided with a supply of about 88,000 and 78,000 gallons per month respectively by means of hand pumps fixed at Manholes in the conduit. As this conduit has been found insufficient to meet the growing demand of the City, a Second Rectangular Masonry Conduit 6′—6″ × 4′ with an arched roof and with a maximum carrying capacity of 32 million gallons of water per day has been constructed at a cost of about Rs. 51 lakhs and was brought into use in 1949.

Filtration and Chlorination.

The raw water as it enters the Water Works Compound through both the conduits is treated with a preliminary dose of chlorine. At the Kilpauk Water Works there are 17 Slow Sand Filters ; 14 of which measuring 200′ × 100′ were constructed and brought to use in 1914 ; while the remaining three filters 200′ × 130′ each were constructed in 1923.

The filtering materials of these Filters consist at present of 6″ of fine sand supported on 2 inches of coarse sand which rest on a 2 inch layer of 3/8 inch stone which again rests on another 2 inch layer of ¾″ stone. Below these are the loose brick collecting cross drains leading to a central longitudinal drain which is sunk below the floor of the filters. The prechlorinated raw water percolates through the above filtering media, runs down the central longitudinal drain and comes out into a rectangular Chamber which contains an automatic outlet regulator. The average rate of filtration is about 8″ vertical per hour. The filtrate from all the above filters flows through the filtered water conduit into four underground covered storage tanks all together capable of storing 6½ million gallons. Three of the tanks measure 150′ × 150′ and the fourth tank measures 190′ × 190′ with a depth of 10′ of water in



KILPAUK WATER WORKS

each. These tanks are intended to provide adequate storage to serve as a balance between the rate of filtration and the rate of pumping water to the City. The four filtered water tanks are independent of each other so that each one of them can be isolated for cleaning without interfering with the working of the others. All the filtered water is again chlorinated just before it enters the filtered water tanks with an average dose of one part of chlorine per million parts of water, to sterilize the water and make it safe for drinking purposes. Besides the two overseers who are in charge of maintaining the Filter beds, a full time Chemist is employed at the Water Works to supervise the chlorination of water supply.

The slow sand filters installed in 1914 did not give satisfactory results even from the beginning and the question of finding a suitable method of filtering and purifying the Red Hills Water has been engaging the attention of the Corporation and Government for the past nearly 40 years. Finally the Government have recently approved the proposal of the Corporation to install for the present a rapid mechanical filter plant of 10 million gallons per day capacity to deal with the additional quantity of water required for the city supply.

Due to the increased supply of water to the city, the storage capacity of the filtered water tanks existing at present is found inadequate and hence a scheme for the construction of two additional underground filter water storage tanks of capacity of 2.08 million gallons each has also been sanctioned at a cost of Rs. 10.69 lakhs and work in this scheme has already been commenced. The size of these two tanks will also be 190′ × 190′ × 10′.

Pumps and Balancing Tank.

From the filter water tanks, water gravitates to the suction culvert leading to the pumps whence it is pumped into the distribution system through two 48″ Pumping Mains each about 3000 ft. in length. The first pumping main which is of steel was laid in 1914 while the 2nd pumping main which is of cast iron pipes was laid and brought to use only in 1955.

A steel circular elevated tank 104 ft. in diameter 28 ft. high with a capacity of 1½ million gallons is connected to the Pumping Mains close to the Pumping Station so as to act as a balancing tank between the pumps and the distribution system.

When the quantity of water pumped is greater than the consumption of water in the city, the tank will store the excess quantity and will supply the same to the city when the pumping is less than the demand in the city. With a view to maintain an adequate

pressure all over the city, the tank has been designed with its bottom 37 feet above ground level and water may be stored upto a height of 65 ft. above ground level. The tank is supported by an external ring of brick piers and arches, while steel stanchions surrounded with brick work are used for the central supports in order to minimise the weight which if only brick supports were used would be greater than the safe limiting pressure on the ground on which the foundations rest.

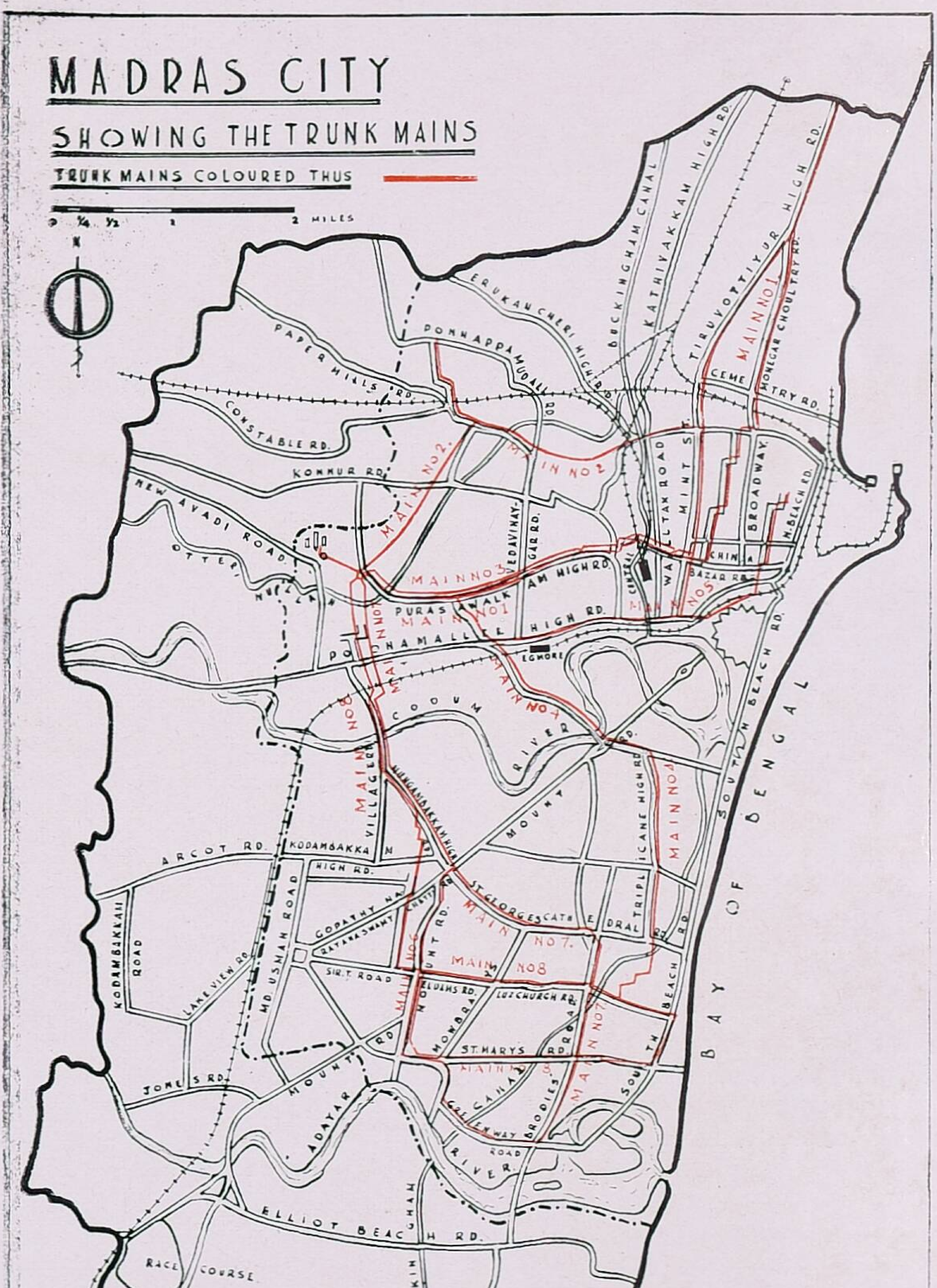
There are three pumping units run by steam power and 3 electrical units at Kilpauk Pumping Station. The three steam pumping plants installed in 1914 comprise of 3 high duty Worthington direct acting pumping engines each capable of delivering 12,000 gallons of water per minute against a total head of 80 feet. Four Babcock and Wilcox boilers are provided to supply steam to these units. Three of these units were provided in 1914 and the fourth boiler was erected in 1930. The boilers were originally fired with coal till about 1929 and thereafter they were converted to oil firing. Again during 2nd World War the shortage of furnace oil forced the Corporation to convert the boilers to coal firing temporarily. But now all the boilers are fired only with furnace oil.

The existing steam engines have served for over 40 years and are so worn out that they cannot be depended upon any longer. They require urgent replacement. The question of installing a Diesel *cum* Electrical unit is under consideration.

In addition to the 3 steam engines, there are at present 3 electrical units. Two of these were installed in 1936 and the 3rd was added in 1950 to meet the increased quantity of pumping for the growing needs of the city. The electrical units are each capable of pumping 20,000 gallons per minute against a total head of 80 feet. At present the electrical units do most of the pumping and the steam engines are used to supplement the pumping during peak demand hours daily in the mornings and evenings only.

Distribution System.

The city distribution system consists of 42 miles of Trunk mains and sub-mains varying in size from 48″ dia. to 9″ dia. nearly 438 miles of distribution and street mains varying in size from 8″ to 4″ and a few lengths of 3″ and 2½″ street mains and riders. The five Trunk Mains which supply the several parts of the city branch off from one of the two 48″ steel pumping mains which end at the place known as the Kilpauk Shaft about 3,000 ft. from the Kilpauk Water Works Pumping Station. At this place there are Valves fitted on to each of the Trunk Mains to enable the regulation of pressure on the trunk mains suitably at different parts of the day.


MADRAS CITY
SHOWING THE TRUNK MAINS
TRUNK MAINS COLOURED THUS
0 ¼ ½ 1 2 MILES
N
BAY OF BENGAL
MAIN NO 1
MAIN NO 2
MAIN NO 3
MAIN NO 4
MAIN NO 5
MAIN NO 6
MAIN NO 7
MAIN NO 8
BUCKINGHAM CANAL
KATHIVAKKAM HIGH RD.
TIRUVOTTIYUR HIGH RD.
MONEGAR CHOULTRY RD.
CEMETRY RD.
ERUKANCHERI HIGH RD.
PONNAPPA MUDALI
PAPER MILLS RD.
CONSTABLE RD.
KONNUR RD.
NEW AVADI ROAD
OTTERI NULLAH
PURASAWALKAM HIGH RD.
POONAMALLEE HIGH RD.
EGMORE
CENTRAL
WALLTAX ROAD
MINT ST.
BROADWAY
CHINA BAZAR RD.
N. BEACH RD.
SOUTH BEACH RD.
COOUM RIVER
MOUNT RD.
VILLAGE RD.
NUNGAMBAKKAM HIGH RD.
TRIPLICANE HIGH RD.
ST. GEORGES CATHEDRAL RD.
ARCOT RD.
KODAMBAKKAM HIGH RD.
KODAMBAKKAM ROAD
LAKE VIEW RD.
MD. USMAN ROAD
GOPATHY NAR RD.
RATANASWAMY CHETTY RD.
SIR. T. ROAD
ELDAMS RD.
LUZ CHURCH RD.
MOWBRAY RD.
ST. MARYS RD.
BRODIES ROAD
SOUTH BEACH RD.
JONES RD.
ADAYAR RIVER
GREENWAY ROAD
ELLIOT BEACH RD.
RACE COURSE
BUCKINGHAM

Besides these trunk mains the following mains branch off at the Kilpauk Water Works or the Kilpauk Shaft to serve the areas noted against each.

1. A 9″ main laid in 1951 and connected to the 48″ Pumping Main at the Kilpauk Water Works for supplying Alagappa Nagar and Shenoynagar on the zonal system of distribution. The supply to this area is controlled by a separate meter and the quantity supplied is adjusted at the rate of 25 gallons per head per day for the population of the area served.

2. A 6″ main from the Kilpauk Water Works serving the Ayanavaram area which is situated west and north of the Water Works.

3. An 8″ main from the Kilpauk Water Works serving the Railway Colony and the Perambur Workshop.

4. A 12″ main laid in 1952 at the cost of the B. & C. Mills to serve the needs of the Buckingham & Carnatic Mills.

Automatic Electric Boosters.

To remedy the defective supply at the tail ends of the distribution system and in high level areas such as Muthialpet and Mylapore, three automatic electric booster pumps have been installed in 1934 and they are functioning satisfactorily. These booster pumps work from 6-30 a.m. to 10 a.m. and from 4 p.m. to 6 p.m. daily. While these pumps provide a satisfactory supply to the areas for which they are intended, they cause defects in the adjacent areas by the suction effect of the pumps. This point has been taken due note of when similar pumps had to be installed for three other defective areas in Triplicane, San Thome and Mandavalli. In these cases the water from the mains is drawn at night time or during the mid-day period by gravity into underground reinforced concrete storage tanks of 3 lakh gallons capacity each, from which the pumps draw water in the mornings and evenings and supply the areas which they are intended to serve. After the opening of the separate trunk main laid for South Madras in January 1955 the booster pumps working in these areas have been discontinued.

Water Supply to extended areas of the City.

Of the areas newly added to the City limits in April 1946, Sembiam and Saidapet areas are having protected water supply systems of their own from infiltration galleries. After the new areas were taken over by the Corporation, Red Hills water supply

has been extended to certain areas in Ayanavaram, Aminjikarai, Kodambakkam and Adyar. In some of the outlying villages where it was difficult to extend the protected supply, water is being supplied in mobile tank units mounted on lorries. To serve Gandhinagar and Kasturbanagar which are at the southern end of city, two wells have been constructed at Urur, Adayar and water from these is pumped into an R.C. Overhead tank of 60,000 gallons capacity.

Supply Statistics.

The quantity of water supplied from Red Hills Lake for the area of nearly 30 sq. miles covered by the old city limits as it existed prior to 1st April 1946 is on an average 27 million gallons per day. This works out to an average of 19 gallons per head per day for a population of 14,29,374 as per the census figures of 1951.

The quantity of water supplied to Saidapet and Sembiam from the infiltration galleries is on an average 1.8 million gallons and 0.50 million gallons respectively per day.

House Services and Metered connections.

There are nearly 62,000 private house connections given from the Corporation Water Mains in the City connected to the Red Hills Supply, which have to be supervised and maintained by the Corporation. Sembiam has no private house connections whereas in Saidapet there are 147 private house connections.

The work inside the private houses have to be done by Plumbers licensed by the Corporation while the portions of the house services which are in the Street Limit have to be maintained by the Corporation at the cost of the respective owners or occupiers. Private house connections are allowed to all buildings which are separately assessed and which have an annual valuation of Rs. 60 and above. Ordinarily two taps with a $\frac{3}{4}''$ service pipe are allowed without a meter for domestic houses. About 4,728 connections given for private houses and for Industrial or Trade purposes are metered connections.

In addition to the private house connections there are about 2,904 Fire Hydrants, 4,102 Public Fountains, 148 Bathing Fountains and 49 Cattle Troughs in the city as on 31st March 1955.

Analysis of water.

There is a full-time Water Analyst with a well-equipped laboratory just outside of the Water Works Compound, who takes

samples of water from the Filter Beds every day and from the Distribution System at frequent intervals and conducts a thorough bacteriological and chemical examination of the same. He is provided with a motor van at the expense of the Corporation to enable him to take samples from various points in the distribution system and to chlorinate the water in the mains at the points where there is need. A special chlorinating apparatus capable of injecting chlorine solution directly to the water mains was purchased in 1950 and is now being used for the purpose of sterilising the water mains. The Analyst is working under the direct supervision of the Health Officer.

Receipts and Expenditure.

For the maintenance of the Water Supply System in the City, the Corporation levies water tax at 1½ per cent of the annual value of all premises in the city and the total revenue derived in a year is Rs. 10 lakhs approximately. Besides this, the income derived by way of excess water charges from metered connections, supervision charges levied on the work of private house connections, etc., works out to Rs. 12.00 lakhs per annum approximately.

As against these revenues, the Corporation spends nearly Rs. 20 lakhs per annum on the maintenance of the Water Supply System in the city including the annuity for repayment of all loans taken for the execution of the various items of Capital Works.

The total expenditure so far incurred by the Corporation on Capital Water Supply Schemes is Rs. 317 lakhs vide tabular statement appended.

CHAPTER II

FILTRATION AND PURIFICATION.

The scheme for slow sand filters for the Madras Water Supply was first formulated in 1905-1906. The sanction for the scheme was accorded by the Government in G.O. No. 635-M, dated 2—4—1906.

1. " Slow Sand Filtration combines simplicity, economy and efficiency in working."
2. " Other systems of purification are expensive. The processes are very complex and require unremitting care and intelligence etc."
3. " No time need be lost or expense incurred in making further experiments."

These were some of the opinions expressed at that time and were uncontroverted. Thus the scheme for slow sand filters came to be adopted for Madras Water Supply. The original scheme of Mr. Madeley had provided for 21 numbers filters 200′ × 100′ to be worked at the rate of 4 inches vertical per hour capable of filtering about 1 million gallons of water per filter per day. But only fourteen of these were constructed for immediate use and these were completed in 1914 at a cost of Rs. 5.80 lakhs. The cost of construction of 3 storage tanks of 1.5 million gallons capacity each for storing filtered water (prior to pumping) came to Rs. 1.52 lakhs.

In actual working, these 14 filters could not be made to yield more than 10 to 12 million gallons of water per day, but the City's demand exceeded this limit. Owing to the financial stringency caused by the outbreak of the First World War of 1914, further extension of the filters became impossible. All attempts to keep the City's consumption within the capacity of the 14 Filters having failed, it was decided to make up the deficiency by adding the required quantity of raw unfiltered water to the quantity filtered. Later on, the unfiltered water so added had to be treated with Chlorine or other chemicals. Within a year of the opening of the Water Works in 1914 it was found that the filtration system broke down giving erratic results and producing H_2S in the Filtrate. The outbreak of an epidemic of Cholera in 1918 and subsequently the anxiety caused about the complete breakdown of the Filtration System due to very low lake levels brought matters to a head.

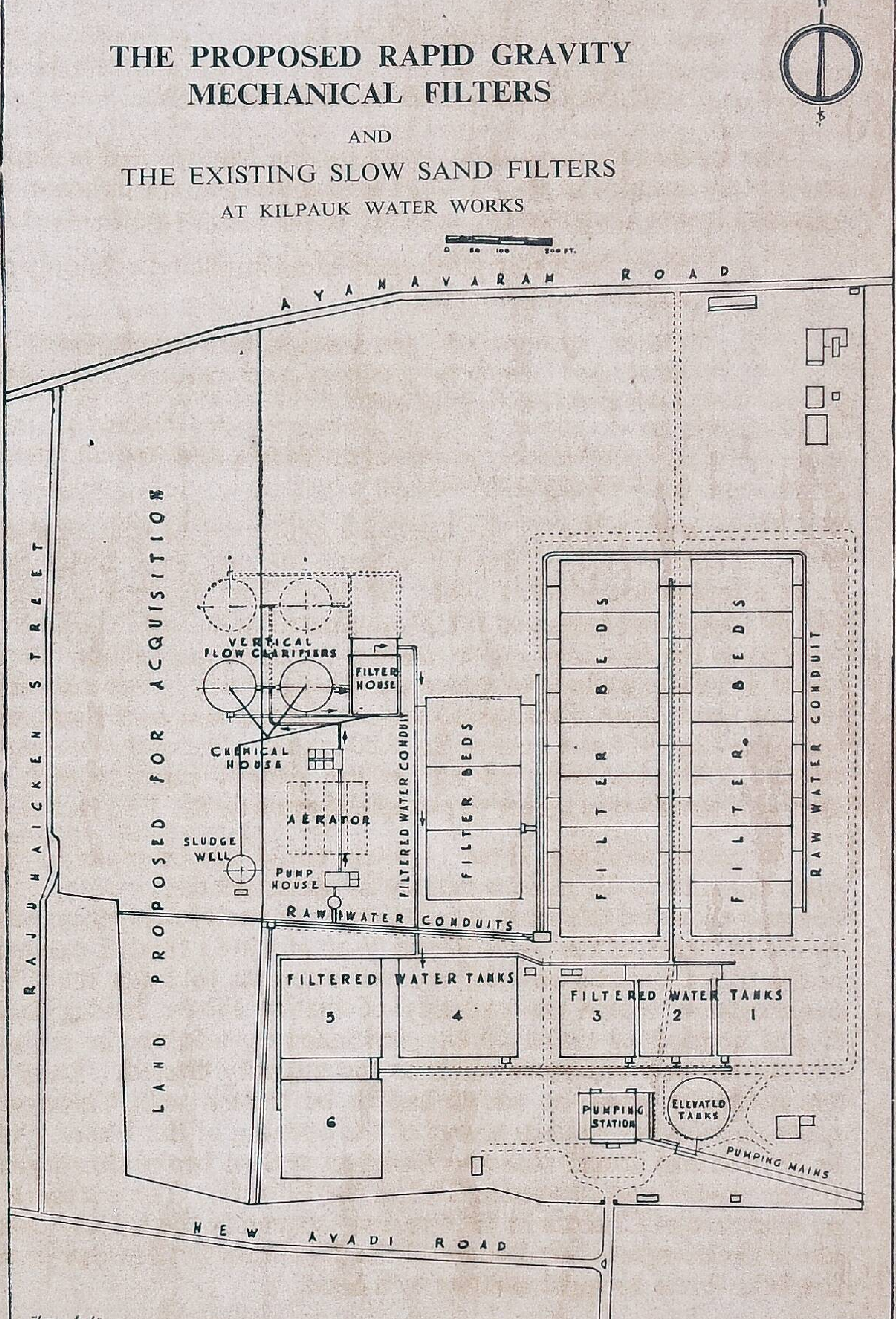
In G.O. No. 1576-M, dated 15—9—1917, the Government appointed a Committee consisting of Surgeon-General Bannerman

THE PROPOSED RAPID GRAVITY MECHANICAL FILTERS

AND

THE EXISTING SLOW SAND FILTERS

AT KILPAUK WATER WORKS



(President) and the Sanitary Commissioner, Major W. A. Justice and the Sanitary Engineer, Mr. W. Hutton to inspect and report on the Water Works and the supply to the City generally. The Committee was further asked to examine carefully the defects of the present system and suggest remedies where necessary. Later, owing to the illness of the President, Mr. Bannerman, the Government omitted him from the Committee and the other two alone formed the Committee. This Committee examined the Madras Water Supply System thoroughly and they submitted a detailed Report on 29—4—1918.

The Committee considered that the quality of the Red Hills Water was on the whole good, thanks to the large area of the Tank and the sunning and sedimentation the water received in it. They however, suggested certain additional precautions to prevent contamination of the tank water from the area immediately surrounding the margin of the Lake and the Banks of the Supply Channel from Cholavaram Tank. They also suggested that the Roughing Filters at Red Hills should be used as mere sedimentation and sunning basins and that these should not be filled with broken stones. With regard to the Filters at the Kilpauk Water Works, they suggested that the underlayers and the broken stones be extended right up to the walls of the Filters without leaving any gap as the space so left was occupied by the superimposed sand which they considered was partly responsible for the formation of H_2S because this margin of sand constituted a dead end in which there was partial stagnation of water. They expressed the view that the creep down the side-walls of the Filters is found in practice not to exist in a properly worked Filter.

They also expressed the view that the sand used was coarser than specified and was not washed as originally intended. The sand used contained a portion of Iron in the form of Oxide which is acted on by the decomposing albuminoid Nitrogen in the Raw Water resulting in the formation of black sulphide of Iron from which H_2S is produced at places where the free flow of water is retarded. They suggested that better quality of sand containing less Iron should be obtained but from whatever source the same was obtained, they stressed the importance of washing the sand to free it from all impurities before placing it in the filters.

They also suggested the construction of two additional filters to avoid the use of the unfiltered water to meet the city demand. The report contains other suggestions for the improvement of Madras Water Supply in general, but as far as Filtration and purification of water are concerned, the above points are the most important.

As a result of detailed inspection by the Surgeon-General Gifford in consultation with Major J. Cunningham and Major Morrison, the Government in G.O. No. 546-M. (Press), dated 22—4—1920 observed that " Sand Filters alone, even of the most perfect type and under the most careful daily supervision cannot be depended on to clear the water of all disease germs " and recommended " that the work of the sand filters should be supplemented by Chlorinating the water before it enters the Conduit ". The recommendation was accepted by the Corporation and an experimental Chlorinating Plant was first erected at Kilpauk and completed in 1922. The Chlorine manufactured by the Plant was utilised in treating the unfiltered portion of the City Water Supply. As the chlorine got from the Experimental Plant was not sufficient, bleaching powder was also used for chlorinating the supply. Later on, another chlorinating plant was installed at Red Hills also to treat the Raw Water before it entered the conduit in the hope that it would (1) Control the growth of algae in the conduit, (2) lengthen the life of the filters, and (3) probably decrease the Sulphuretted Hydrogen nuisance.

Pending further investigation three more Slow Sand Filters 200′ × 130′ were also added in 1923 to meet the growing demand for water in the City making a total of 17 filters out of 21 filters originally proposed. But the defects in the filtration system remained all the same.

Appointment of Government Filtration Committee.

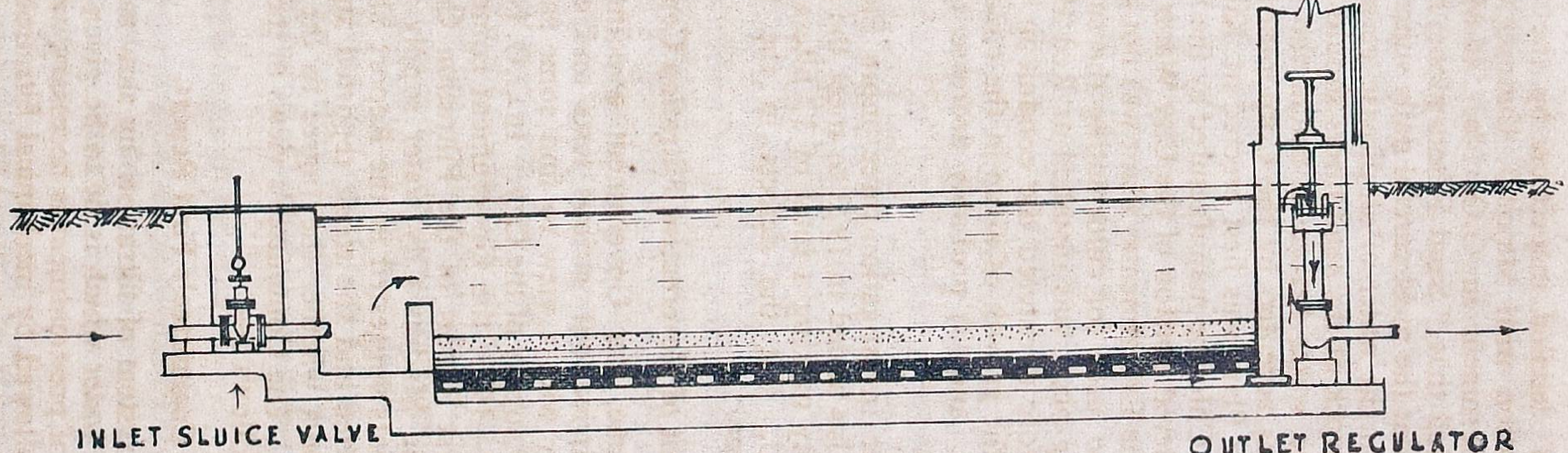
In the meantime, the Government appointed a Filtration Committee who carried out various tests and experiments with the Red Hills water with a view to find some satisfactory means of filtering the water supply of the City. In G.O. No. 1934, L. & M. (Press), dated 1—9—1923, the Government communicated to the Corporation the first Report of the Filtration Committee on the then position of the Madras City water supply with the remark " that the experiments suggested in the Report should be carried out by the Committee and the result reported and requesting the Corporation to report whether they agree to the adoption of the course suggested ". The Committee's views in the first report may be summarised as follows :—

Committee's First Report.

" The present system of filtration by slow sand filters cannot by itself produce a water which is fit to be given to the people to drink. Some sort of pre-treatment is necessary with Alum or some other precipitant followed by mechanical filtration and subsequent chlorination possibly on the lines by which a successful result is most

CROSS SECTION OF SLOW SAND FILTERS

AT KILPAUK WATER WORKS



FILTERING MEDIA From Top to Bottom.

Fine Sand	6″
Coarse Sand	2″
$\frac{3}{8}$″ B.G. Jelly	2″
$\frac{3}{4}$″ B.G. Jelly	2″
Two Layers Bricks	6″

likely to be obtained ". The Committee in the said report did not recommend any one method of filtration for adoption, but they recommended that these experiments should be carried out on 4 or 5 different systems. Mr. Madeley who was the then Special Engineer to the Corporation of Madras and who was also one of the members of the said Committee submitted a detailed report on 8—11—1923 reviewing the various possible methods applicable for the Madras Water Supply with respective costs and giving his opinion on each of them. His final recommendation was for adopting 'Rapid Filtration preceded by sedimentation, sunning and aeration.' This scheme sought to include the utilisation of all the existing works involving the least expenditure. At the same time it was based on the principles put forward by the Water Filtration Committee. The matter was placed before the Corporation Council, who on 20—12—1923 passed the following resolution :—

" While the Council desires to express its recognition of the work done by the Water Filtration Committee and its appreciation of the valuable review of the situation presented in the report, it resolves that having regard (1) to the cost of carrying out the further experiments recommended by the Committee (2) to the fact that the Special Engineer has put forward certain concrete proposals and has pointed out that if his proposals are adopted it will be unnecessary to carry out the further experiments suggested in the report, the proposals contained in the Special Engineer's note dated 8—11—1923 be forwarded to the Government with the request that they be forwarded to the Filtration Committee for report and that the advice of Col. Clemesha be obtained on the proposals and in the meantime, the three new filters be used as Slow Sand Filters ".

The resolution was forwarded to the Government who in turn addressed the Filtration Committee in the matter. The Filtration Committee submitted their final report on 17—6—1924 which was forwarded to the Corporation for remarks by the Government with their Memo No. 17929-1, L. & M., dated 24—6—1924. The Committee in reviewing the report of the Special Engineer recommended the adoption of Rapid Filtration but did not agree that the present slow sand filter plant would be all utilised.

The Committee's findings were :—

(*a*) that slow-sand filtration by itself has entirely failed and cannot be made to produce a potable water from Red Hills water dealt by the Corporation filter plant at Kilpauk ;

(*b*) that a Mechanical (Rapid) Filtration process should be adopted for the whole of the Madras Water Supply ;

(*c*) that with such a scheme the whole of the slow sand filters may not remain in effective use ;

(*d*) that tenders be called for such a mechanical filter plant specifying (1) that a definite standard of purification should be obtained as the result of the filtration alone and that it should cover all states of the raw water, and (2) a maximum cost per million gallons filtered for maintenance.

Col. Clemesha, who was asked by the Corporation to advise in the matter inspected the Water Works and made a report on 26—1—1925. He agreed with the Filtration Committee's recommendations on the subject. Briefly his recommendations were :—

(1) that slow sand filtration by itself of the Red Hills water cannot produce a satisfactory drinking water ;

(2) that mechanical or rapid filtration is the best method of obtaining this result ;

(3) that the alternative method of pre-sedimentation and alum will give inferior results and will be more costly to install and to work ;

(4) that the old filters can be utilised as settling tanks before the filtration process; and

(5) that the chlorination of the raw water should be conducted only in times of emergency.

The report of Col. Clemesha and that of the Filtration Committee were considered by the Corporation Council on 5—5—1925 who resolved " that the work of constructing 5 more filter beds making up a total of 22 be taken up immediately ; that water be filtered by slow-sand filtration and that unfiltered water which might have to be added should be chlorinated before being mixed up with the filtered water for the present ". From a perusal of the detailed minutes of the proceedings it is seen that the Council hesitated to adopt mechanical or rapid filters in spite of Col. Clemesha's advice for the following reasons :—

(1) Initial and recurring costs were prohibitive and economically impracticable as Mr. Madeley advised.

(2) Installation of the mechanical filters would mean the scrapping of existing 17 sand filters constructed at a cost of about Rs. 12/- lakhs.

(3) The amount of waste water required is at least 5% in the opinion of the Council which the Corporation cannot afford to spare at present.

(4) With mechanical filters, chlorination was still necessary as a daily routine and safeguard.

(5) The two chief essentials for a potable water supply being (1) clarity and (2) bacterial purity and as these are achieved by slow sand filtration and chlorination, there was no necessity to go in for mechanical filters which did not ensure bacterial purity but only clarity.

(6) Results and experience in Bombay and Bengal did not justify embarking on such an expensive method.

The resolution of the council was more or less a mandate on the Executive to exploit and improve on slow sand filtration. Accordingly Mr. Hensman, the then Engineer, Corporation, converted one of the sand beds into a double filtration bed, one-fourth of the area was filled with coke and the other three-fourth retained as sand bed. The raw water was filtered through the coke compartment before it was filtered through the sand compartment. This bed was in the beginning giving consistent results but later on the results were unsatisfactory and the experiment had to be given up. In the meantime the Government to whom a copy of the Council resolution dated 5—5—1925 was communicated, passed orders in G.O. No. (Press) 4345 L. & M., dated 30-11-1925 declining to sanction the proposal for the construction of the additional filter beds and stating that in the interests of the health of the population of the city *rapid filtration should be employed at once*, for the water which was then chlorinated and filtered. Again in Memorandum No. 11498-1 L. & M., dated 26—4—1926 the Government forwarded the report of the Director of Public Health to the effect that the water from the taps was worse than the water entering the conduit and requesting the Commissioner to report what action the Council proposed to take in the matter. The Director, King Institute, Guindy, in his letter dated 28—5—1926 pointed out that the making of a harbour at Red Hills and coke well at the roughing filters suggested by the Engineer, Corporation of Madras, was unjustifiable and urged the immediate installation of rapid filters for the unfiltered portion of the water supply. The Engineer in his note dated 12—6—1926 pointed out that the results obtained by Mechanical filtration in other places were not encouraging besides the heavy cost involved. The Commissioner in his note dated 28—6—1926 stated that the results so far produced by coke filtration were not wholly satisfactory and recommended the adoption of rapid filtration without any further delay on the lines suggested by the Director, King Institute, Guindy. A joint conference of the Standing Committees (Works) and (Health) was called for considering the subject.

But before they could dispose of the subject, it was decided to hold a Round Table Conference of the following officers to arrive at a quick and satisfactory solution :—

1. The President, Corporation of Madras,
2. The Commissioner, Do.
3. The Chairman, S. C. (W). Do.
4. The Engineer, Do.
5. The Health Officer, Do.
6. Dr. B. S. Mallayya,
7. The Director, King Institute, Guindy,
8. The Director of Public Health,
9. The Sanitary Engineer,
10. The Surgeon-General, and
11. The Secretary, Local Self-Government Department.

The Conference was held in the Cabinet room in the Secretariat buildings on 17—11—1926 and the following decision was arrived at :—

(1) Corporation to make arrangements to chlorinate the water at Red Hills.

(2) Government to install a small experimental mechanical filter plant at the Kilpauk Filter Beds and work the same for some time and see the results as regards costs, purification etc.

This was approved by the Corporation Council on 15—12—1927, the cost of the experiments being met from Provincial funds.

The Government Committee on Water and Sewage Purification accordingly carried out various experiments during 1927-28 and submitted four reports, definite proposals being contained in their III report. They recommended the installation of Percolating filters as primary filters and the treatment of the effluent from these through the existing slow sand filters at 8″ per hour which is double the normal rate of 4″ per hour. This III report was forwarded to the Corporation for remarks by the Government in G.O. No. (Press) 709, P.H., dated 15—3—1929. On 1—10—1929 the Corporation Council approved of the Committee's proposals. The Sanitary Engineer to Government was requested to prepare necessary detailed plans and estimates for the installation of percolating filters. A sum of Rs. 12,000/- was also paid to the Sanitary Engineer to the Government for this purpose as per Council resolution

dated 10—6—1930. On 8—10—1931, the Government again forwarded to the Corporation for remarks the report of the Water and Sewage Purification Committee recommending the installation of two units of percolating filters in the first instance.

At its meeting held on 19—7—1932, the Corporation Council passed the following resolution in respect of the introduction of percolating filters :—

(1) " That the Sanitary Engineer to the Government should prepare detailed plans and estimates for which the Corporation has paid long ago.

(2) That the Council sanctions the expenditure of Rs. 50,000 for the construction of two units of percolating filters as an experimental measure provided that the Government give an assurance that the total cost will be found by them half as grant and half as loan.

(3) That the Government Committee on Water and Sewage Purification be requested to carry on their further experiments with the two units of percolating filters to be constructed and two of the existing filters as secondary filters and submit their report within one year.

(4) That in the meantime, the water in Red Hills Lake, be treated with copper sulphate as suggested by Col. King and that Rs. 4,000 be sanctioned for the purpose."

The resolution of the Council was duly communicated to the Government with a request to expedite the preparation of plans and estimates by the Sanitary Engineer to the Government.

The Government in their memorandum No. 50928-1-A.2, L. & M., dated 20—12—1933 forwarded the plans and estimates prepared by the Sanitary Engineer to Government and requested the Corporation to report urgently " whether on condition that liability for half the expenditure on the work is accepted by Government, it is agreeable for the execution of the partial scheme as prepared by the Sanitary Engineer ". The Sanitary Engineer's partial scheme consisted of " one percolating primary filter of the type experimented by the Government Committee and one of Paterson's Primary Filter type, each capable of filtering 2 million gallons of water per day at a capital cost of Rs. 1,67,500/- and a maintenance cost of Rs. 29,823/- per annum. It was stated by Government that the recommendations for the full scheme would

be based on the results of the working of these two types of filters and that these two could be incorporated as part of the full scheme. A perusal of the report of the Sanitary Engineer and his estimates indicated that the design of Paterson's was likely to prove considerably more economical than percolating filters. Further the method of washing adopted for the percolating filters of the type experimented by the Government Committee was considered not altogether satisfactory because the materials are handled manually by cooly labour. It was felt that sufficient experiments had been carried out to obtain workable results and any mechanical defects in the design were such as could be satisfactorily tackled by reputed manufacturers of water Purification Plants. Further experimenting was not therefore considered necessary and the Corporation Council at its meeting held on 17—7—1934 resolved to call for tenders for a suitable plant for the *full comprehensive scheme.* It was expected that the proposals of the Sanitary Engineer to Government would be covered by some tender or other.

Tenders were accordingly called for and five tenders were received on 25—9—1935. The specification drafted included all available data for the information of the prospective tenderers and the only limitation that was sought to be imposed on them was conformity with the standards of purity specified by us in consultation with the Director, King Institute of Preventive Medicine, Guindy. Possibilities of utilising the existing slow sand filters as part of the scheme was also laid down as a desideratum. Despite the wide latitude given to the tenderers, the tenders received were all unsatisfactory or incomplete and were unacceptable for some reason or other. Almost all the tenderers considered the use of the existing slow sand filters as secondary filters as quite unsatisfactory and declined to give the necessary guarantee and standard of purity specified. Almost all of them considered chemical pre-treatment of the water quite essential and opined that " Mechanical Filters alone would give the best results for the Red Hills Water ". It is stated that they had refrained from tendering for such plants on the assumption that the proposals would not receive consideration. It was therefore thought that we might give the option to the tenderers to tender for plants which they considered best, provided they were prepared to give the guarantees asked for. The Standing Committee (Works) of the Corporation had accordingly in their proceedings dated 18—9—1936 rejected all the tenders and asked the Engineer to draft a revised specification in consultation with the Government Committee on Water and Sewage Purification for calling for fresh tenders. The Engineer, Corporation of Madras, wrote to the Director of Public Health who is the Chairman of the Government Committee on Water and Sewage Purification for advice in the matter. A meeting of the Government Committee

was held at Kilpauk on 30—10—1936 to discuss the subject when the Engineer, Corporation of Madras and the Assistant Engineer, Water Works, were present. The Engineer explained to the members how the matter stood at the time and asked for their advice as to the lines on which the revised specification was to be drafted. The Committee's views in the matter are briefly embodied in the D.O. letter dated 2nd November 1936 addressed to the Engineer, Corporation of Madras by the Chairman of the Committee.

The Committee stated that they saw no reason to alter or modify their recommendation for Percolating pre-filters but said that the installation of up-to-date mechanical rapid filters would be the ideal course to adopt for producing a good water supply to the city and that the percolating filter scheme had to be worked out only because all the possible means of utilising the sand filters as such had to be explored. The Committee added that this recommendation for mechanical rapid filters was made by them as early as 1923 but that the Corporation would not accept it then, because they did not want to scrap the existing sand filters. Then the Committee finally stated that in the light of the Corporation's changed attitude now towards mechanical filters, the Corporation should pass a specific resolution to that effect and move the Government to reconsider the matter before the Committee could agree to take any further action. The Government also in G.O. No. Ms. 156, dated the 21st January 1937 called for the views of the Corporation Council on the note of the Government Committee with regard to the then position of the city water supply purification scheme. The whole matter was considered by the Works Committee on 29—1—1937 when the Sanitary Engineer to the Government was also present. The latter stated that he saw no reason to alter or modify the original recommendation made in 1933 for the installation of two large size units of pre-filters, one of the percolating and one of Paterson type, of a two million capacity each. The Standing Committee thereupon resolved to reconsider the estimates for these two full size units along with the schemes for the purchase of irrigation rights and duplication of conduit. Accordingly estimates for Rs. 8.00 lakhs and Rs. 1.50 lakhs for duplication of conduit and purchase of irrigation rights were placed before the Standing Committees and Council and were sanctioned separately on 21—9—1937. In the meantime on 7—8—1937 the Members of the Standing Committee (Works) and the Mayor and Commissioner inspected the Kilpauk Water Works and the Red Hills Lake, with the members of the Government Filtration Committee consisting of the Director of Public Health, Director of King Institute, Guindy, and the Sanitary Engineer to Government. As a result of the discussions held at the above inspection, the Works Com-

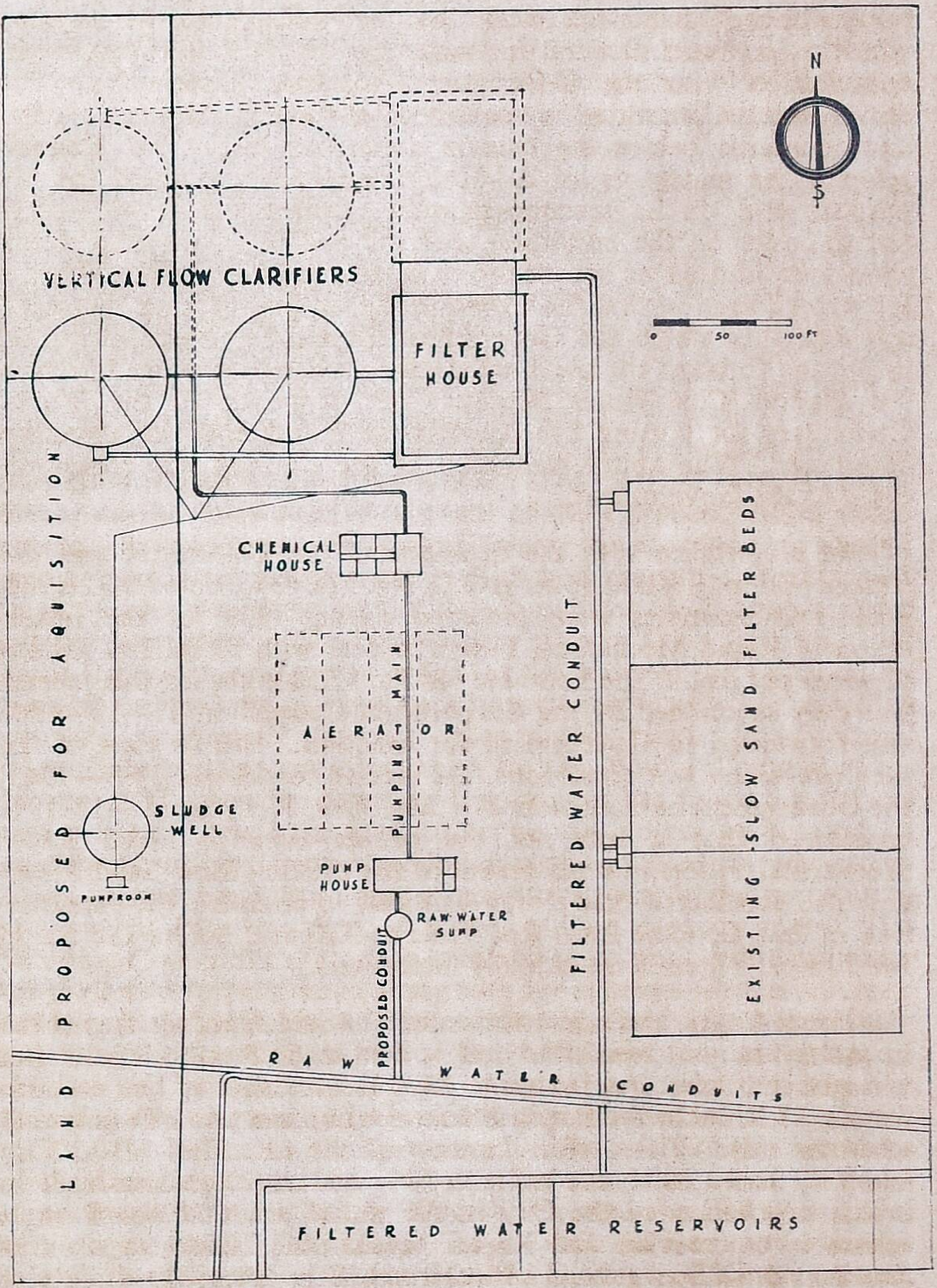
mittee at its meeting held on 10—8—1937 resolved as follows :— " This Committee recommends to the Council to rescind its resolution dated 5—5—1925 namely that Sand Filters be utilised in addition to any scheme for mechanical filtration ". Resolved that for the present, five mechanical filters be installed in order to cope with the increased demand for water and tenders be called for in consultation with the Government Filtration Committee. The Government Committee is requested to suggest the specification and standards before the tenders are called for. The Council referred the matter to an Ad-Hoc Committee appointed for the purpose and on its recommendation resolved on 21—12—1937 not to insist on the condition that the existing slow sand filters should be utilised as secondary or auxiliary filters in any scheme for water filtration that the Committee may put up, thus removing any disability which the Government Committee might have had in putting forward the most satisfactory scheme of water filtration for Madras City Water Supply. The proposals of the Works Committee for putting five Mechanical Filters was not therefore considered. The above resolution of the Council was communicated to the Government.

In accordance with the decisions of the Committee and the standards of purity laid down in G.O. No. Ms. 4345, dated 5-12-1938, plans and estimates were prepared during 1939 for the installation of Rapid Mechanical Filters to deal with 32 million gallons of water per day. The Estimate for Rs. 17.50 lakhs for this scheme was duly sanctioned by the Corporation Council on 21—12—1940 and forwarded to Government for sanction. But in view of the then prevailing war conditions (the second world war 1939—1945) the Government in their order No. Ms. 5089, P.H., dated 4-12-1941 considered that it was not the proper time to instal Rapid Mechanical Filters in replacement of the existing Slow Sand Filters and also considered that it was desirable to complete the construction of 2nd Conduit from Red Hills to Kilpauk before the Rapid Mechanical Filters were actually introduced.

Accordingly, the construction of the 2nd Conduit was taken up after the war was over and it has since been completed and brought into use. At the same time the revision of the estimate for Rs. 17.50 lakhs for Rapid Mechanical Filters was also taken up after the close of the war. In view of the extension of the City limits by about 20 square miles in 1946 and the enormous increase in the population of the City in the recent years, it was thought advisable to provide for Rapid Mechanical Filters capable of filtering 40 million gallons of water per day. A rough outline of the revised layout and plans prepared by the Corporation were approved by the Chief Engineer to Government in February 1947,

LAY-OUT OF PROPOSED RAPID GRAVITY MECHANICAL FILTERS

AT KILPAUK WATER WORKS



and, thereafter, detailed plans and estimates for Rs. 77.50 lakhs for the installation of Rapid Mechanical Filters of 40 million gallons per day capacity were prepared. This estimate for Rs. 77.50 lakhs was approved by the Corporation Council on 14—4—1948 and forwarded to Government on 30—4—1948 for sanction and for provision of necessary funds half as loan and half as grant.

While the scheme was under consideration by the Government, the Chief Engineer to Government, P.W.D. suggested that instead of Mechanical Filters the Micro-Mesh method of filtration might be suitable as a pre-filtration method with the existing slow sand filters at the Kilpauk Water Works. Government accepted the suggestion of the Chief Engineer, P.W.D. and in their order No. 4285 P.H., dated 5—12—1949 sanctioned the installation of a Pilot Plant of Micro-Mesh Filter unit at a cost not exceeding Rs. 1.00 lakhs and advised the Chief Engineer to obtain and instal the plant and to try it for one year and report the result. The cost of the above experiment has to be borne entirely by Government. The question of installation of Rapid Mechanical Filters was deferred pending completion of the trial of the Micro-Mesh Plant.

The Corporation in its letters W.W.D.C. Nos. L. 4898/46, dated 29—12—1949 and 29—8—1950 addressed to Government explained that the proposed experimentation with the Micro-Mesh Plant was not likely to prove successful with the Red Hills water as it contains a large percentage of organic matter in Colloidal from which could not be removed either by Micro-Mesh Plant or by Slow Sand Filters. It was further pointed out that any experimentation will only lead to the postponement of the installation of Rapid Mechanical Filters already decided upon by the Government and by the Corporation as the best method of purifying the Madras water. Government were therefore requested to drop the proposal for further experimentation with the Micro-Mesh Plant and to sanction the estimate for Rs. 77.50 lakhs for the installation of Rapid Mechanical Filters.

Government in their Order No. M.S. 186-H, dated 18—1—1951 decided on the recommendation of the Chief Engineer and on the resolution of the Water and Sewage Purification Committee dated 4—8—1950, that while Micro-Mesh Plant should be tried as already ordered by Government, Rapid Sand Filters should be provided for part of the quantity of water required for immediate use of the city. Detailed plans and estimates for the Partial scheme of Rapid Mechanical Filters to deal with 10 million gallons per day were ordered to be prepared by the Corporation and submitted to Government for sanction. Accordingly detailed plans and estimates for Rs. 25.75 lakhs for the above partial scheme was prepared by the

Corporation and forwarded to Government on 16—5—1951 for sanction and to finance the same half as loan and half as grant. Government were also requested to reconsider if possible, their order in regard to the trial of Micro-Mesh Unit and sanction straightaway the full scheme of Mechanical Filters for 40 million gallons capacity.

Subsequently when the Commissioner met the Hon'ble Minister for Public Health at the Secretariat on 12—1—1952, the Commissioner requested that the part scheme for the installation of Rapid Mechanical Filters of 10 million gallons capacity Plant which was already approved by the Government may be sanctioned immediately in the interest of the City Water Supply. In accordance with the above request, Government in their Memorandum No. 22148-W1/51-9-H, dated 25—1—1952 suggested that the Chief Engineer may discuss the issues connected with this scheme with the technical officers of the Corporation and make his considered recommendations to Government on the subject. Accordingly the Water Works Engineer and the Executive Engineer, Water Supply of the Corporation met the Chief Engineer, P.H. at the Chief Engineer's office on 6—3—1952 and impressed upon the Chief Engineer, P.H., of the immediate necessity for the installation of Rapid Mechanical Filters at Kilpauk and the Chief Engineer, P.H. was requested to recommend for sanction at least the partial scheme of rapid filters of 10 million gallons capacity estimated to cost Rs. 25.75 lakhs as early as possible.

In G.O. No. 1169-H, dated 7—4—1952, Government forwarded to the Corporation a copy of the remarks of the Chief Engineer, P.H. contained in his letter No. 2333-Pww-49-95 dated 13—3—1952 and suggested that in view of the reasons stated in the said letter, the Corporation may accept the advice of the Chief Engineer which is reproduced below :—

" In short I would stress the desirability of postponing the consideration of the installation of even the 10 million gallons capacity plant of rapid gravity type filter until we are assured of :—

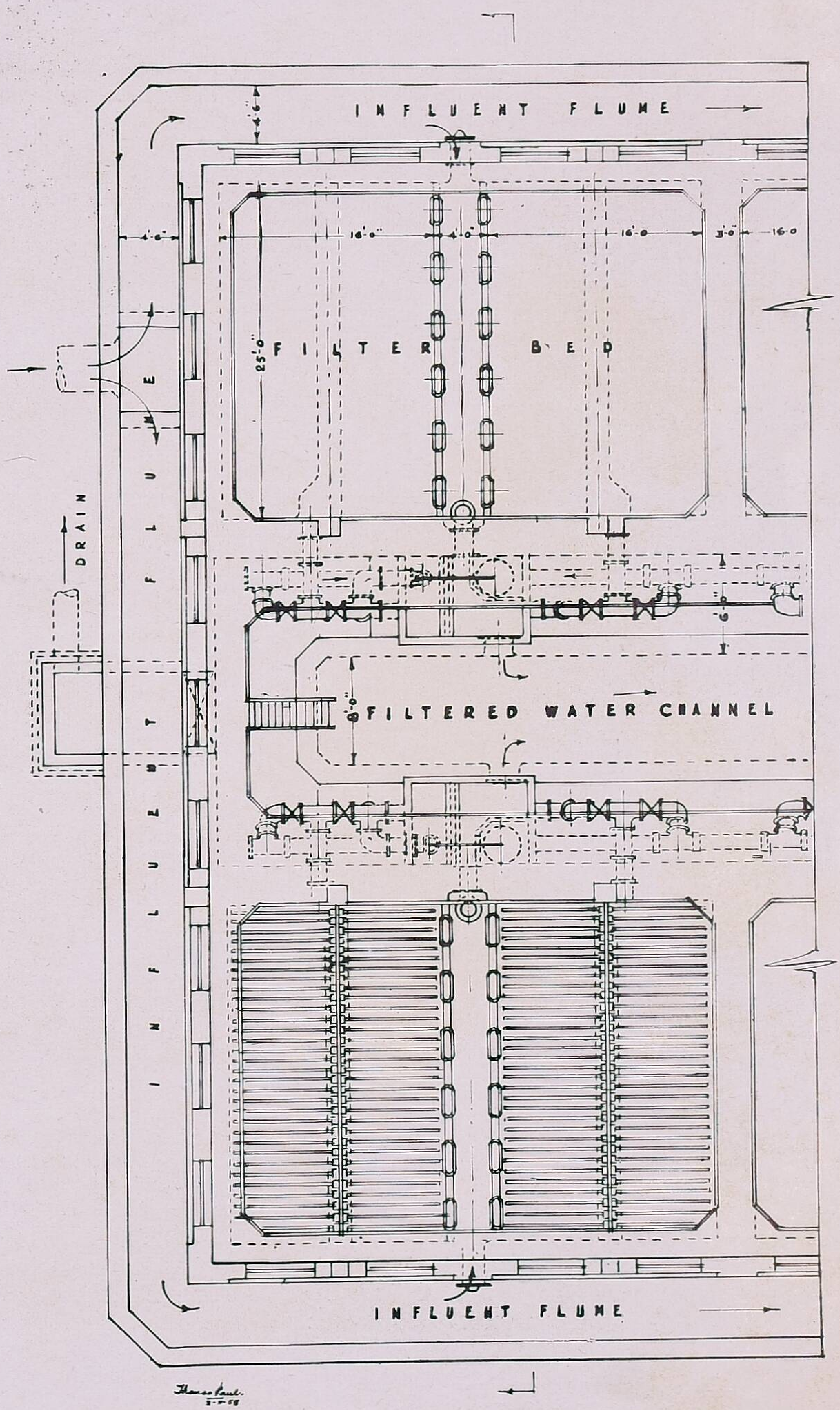
(1) An efficient redesigned distribution system that will take the extra supply fed into it ;

(2) An unfailing supply of water in the lakes ; and

(3) The success or failure of the Micro-Mesh method of filtration and other measures of pre-treatment of the raw water to give us an increased and better supply from the slow sand filters ".

PROPOSED RAPID GRAVITY MECHANICAL FILTERS

PLAN OF FILTER HOUSE



The Corporation Council at its meeting held on 21—10—1952 decided to request Government to reconsider the matter on the following grounds :—

(1) Even after the lapse of two years since the Government sanctioned the experimentation with Micro-Mesh Filtration, the experiments were not started.

(2) The question of installing filters to suit the quality of the Madras-Water has been under consideration of the Government even from 1917 when the existing slow sand filters began giving trouble. From that time, various experiments have been conducted by the Government Committee on Water and Sewage Purification and they have found that the Mechanical Filters are the most suited for the Red Hills Water. There was therefore no need to conduct further experiments.

(3) As regards the availability of an unfailing supply in the lake, though the Corporation has been faced with severe water shortage on account of the failure of the Monsoon for the Five Years 1947—1952 it was pointed out to Government that this state of affairs will not continue for ever. If and when adequate supplies are available it should be possible for the Corporation to supply proper filtered water in the City. This is why the Government in their order No. Ms. 186-H, dated 18—1—1951 considered that at least a 10 million gallons Mechanical Filter Plant be installed immediately to meet the growing needs of the City.

(4) As regards the re-design of the distribution system, though the design can be worked in two or three years, it will take many years to execute the scheme. The question of suitable filter plant for the City cannot be made to wait on account of this.

(5) The scheme for Rapid Mechanical Filters has been pending from 1938 onwards, as the Government had then stated that the Second Conduit should be taken up first and completed before the filtration scheme is taken up. Since then, various improvements connected with the City Water Supply have been carried out or are in progress as detailed below :—

(*a*) The construction of Poondi Reservoir to increase the storage of water has been taken up and completed at a cost of Rs. 65 lakhs between the years 1940—1944.

(*b*) The construction of 2nd Conduit from Red Hills to Kilpauk has been taken up and completed at a cost of Rs. 55 lakhs between the years 1946—1949.

(*c*) Laying of 2nd Pumping Main from Kilpauk Water Works to Shaft—Estimated cost Rs. 8.15 lakhs.

(*d*) Laying of Separate Trunk Main for South Madras from Kilpauk Shaft to San Thome High Road—Estimated cost Rs. 34.56 lakhs.

Besides these, the following improvements to the City Water Supply Distribution System by laying pipes of 4″ diameter and above in various parts of the City under the following sanctioned Schemes have also been taken up and are in progress:—

(*e*) City Distribution System Improvements—Estimated cost Rs. 15.29 lakhs ;

(*f*) Further Improvements to the City Distribution System—Estimated cost Rs. 4.76 lakhs ;

(*g*) Provision of water supply to Gandhinagar layout—Estimated cost Rs. 4.36 lakhs.

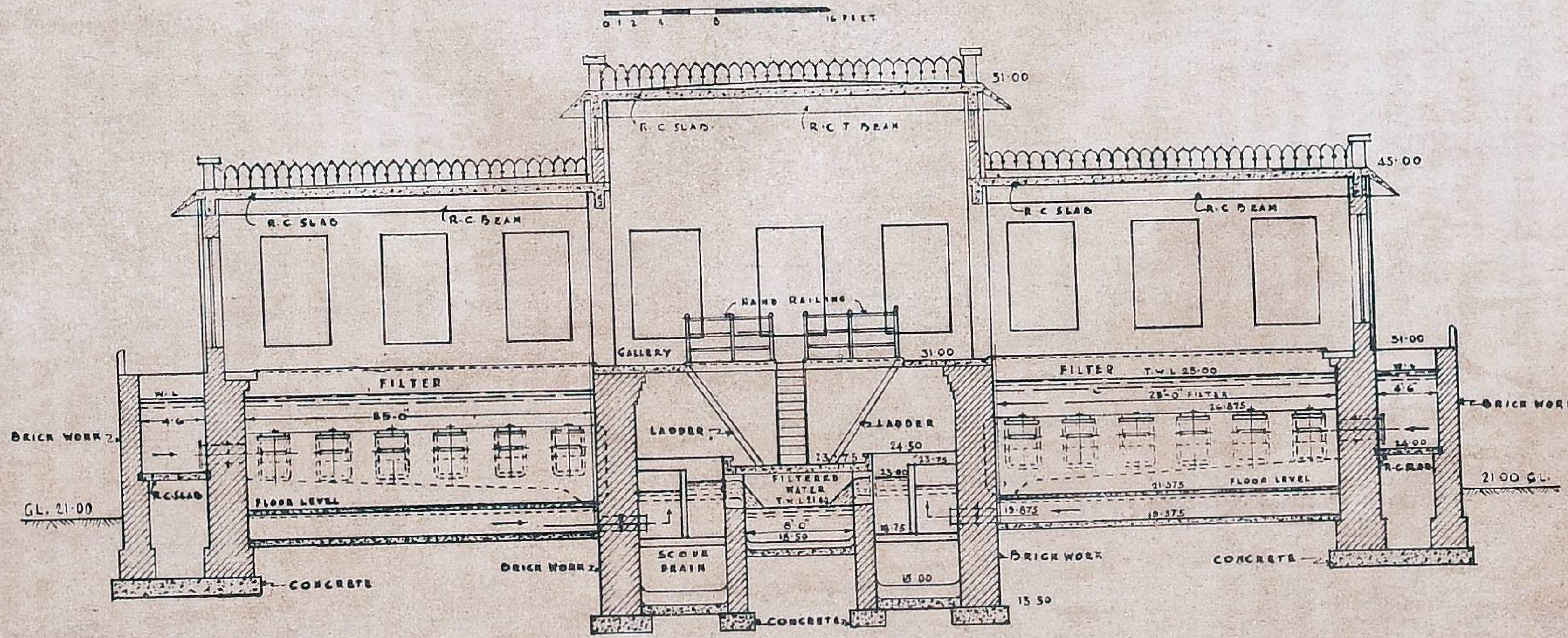
(*h*) Provision of water supply to Alagappa Nagar layout and Aminjikarai extensions—Estimated cost Rs. 2.77 lakhs.

Unless the bottle neck in the filters is removed by installing at least the 10 million gallons filter plant to start with to supplement the water filtered by the Slow Sand Filters, all the schemes which have so far been executed and which are in progress will merely go to waste. Whatever be the quantity of water that may be brought from the Lakes in normal times, it will not be possible to supply more than 24 million gallons per day to the City which was being given since 1936 for a population of 7 lakhs though the population has increased now to 16 lakhs and the extent of the City has also grown from 30 square miles to 50 square miles. The supply of the same quantity of water cannot in any way be called adequate. Unless additional filters are provided, the Corporation will not be able to extend the protected supply to the 20 square miles of extended areas which have been added to the City in 1946.

The Mayor of Madras accompanied by the Commissioner of the Corporation and the Water Works Engineer waited in deputation on the Hon'ble Minister of Health on the 17th March 1953 in the Minister's Chamber at Fort St. George. The Chief Engineer (P.W.D.) (General and Buildings), the Sanitary Engineer to Government, the Secretary to Government and the Deputy Secretary to Government were present. The deputation explained

PROPOSED RAPID GRAVITY MECHANICAL FILTERS

CROSS SECTION OF FILTER HOUSE



and impressed clearly the importance of installing the Mechanical Filters. The need for the installation of Rapid Mechanical Filters was accepted by the Government subject to higher priority being given to Zonal Distribution System and increasing the capacity of Filtered Water Reservoirs. The partial scheme for Rs. 25.75 lakhs for installing Rapid Mechanical Filters of 10 million gallons capacity a day was once again forwarded to Government on 13—5—1953 for sanction. On 10th June 1953, a Conference was held at Secretariat to consider the above matter and it was finally decided to drop the proposal to experiment with the Micro-Mesh plant and to sanction the Mechanical filters.

In their order No. 3019-H, dated 8th November 1954, Government sanctioned the plans and estimate for Rs. 25.00 lakhs for the installation of Rapid Mechanical Filters of 10 million gallons per day for effecting improvement in the quality of the City Water supply. This proposal has also been included in the First Five-Year Plan of the Central Government. Tenders have been received for the supply and installation of the filter plant and they are under consideration by the Corporation Council.

CHAPTER III

CAPITAL WORKS IN PROGRESS AND UNDER CONTEMPLATION

As already stated in the 1st chapter, a beginning was made in 1870 to provide the benefits of protected water supply to the citizens of Madras. Though this system of supply had many defects no major improvements were undertaken till 1914 when the scheme of Mr. Madeley for putting the Madras water supply on a sound basis was completed. Under this scheme, a masonry covered conduit was provided in place of the open earth channel for conveying the water from the Red Hills Lake to the Kilpauk Water Works and arrangements were made at this place for filtering and pumping the water into the Distribution System. The Distribution System was also improved by providing a number of Trunk Mains and sub-mains to feed the areas which they were intended to serve. These improvements may be said to mark the 2nd stage of the development of the scheme of water supply to the city. Many of the faults of the Old System were remedied by this scheme but it was soon discovered that the Slow Sand Filters installed in 1914 did not give satisfactory results. Various experiments had to be made to find out the best method of filtering the Red Hills water as has been explained in detail in Chapter II and only recently it was decided to go in for Rapid Mechanical Filters.

In the meantime, the population of the city began to rise rapidly beyond all expectations and the daily supply to the city had to be increased gradually from about 12 million gallons to as much as 25 million gallons. The storage capacity of the Red Hills lake was just sufficient to ensure this supply to the city but if in any year, the lake did not get full on account of poor rainfall, the city was threatened with water famine and such instances were not infrequent. Additional sources of supply had to be found to meet the growing demand of the city and more particularly to ensure a steady supply during drought years without reduction in the rate of supply. The construction of Sathyamurthi Sagar at Poondi across the Kortalayar was undertaken with this objective in 1940 and was completed and brought into use in 1944. A number of other important water supply schemes were also put into execution to make the additional water available to the city. As the maximum carrying capacity of the conduit constructed in 1914 was only 24 million gallons per day, a 2nd conduit was constructed from Red Hills to Kilpauk to enable another 32 million gallons of water to be conveyed to the Kilpauk Water Works. Additional Pumping sets

were installed at the Kilpauk Pumping Station and the 48″ Pumping Main from the Pumping Station to the Shaft was duplicated to improve the pressure at the distribution point at the Shaft. A separate 42″ trunk main was provided for improving the supply to the South Madras. All these works were done between 1944 and 1955 and cost nearly Rs. 162 lakhs.

Even after all these improvements were done, it has not been possible to increase the daily supply to the city, on account of the inadequacy of the existing filters. After the Rapid Mechanical Filters of 10 million gallons capacity for which the foundation stone has been laid today are installed, it will be possible to supply more water to the city and all necessary steps are being taken to execute this scheme with all expedition.

The problem of providing a satisfactory supply to the city cannot however be said to have been solved yet. Some of the problems which require immediate attention are given below :—

1. Augmenting the source of Supply.

The population of the city is at present about 16 lakhs. To ensure a minimum supply of 25 gallons per head per day for the above population, about 40 million gallons of water are required per day. The Corporation is now supplying only 27 million gallons per day on account of the inadequacy of the existing filters but the supply will be increased as soon as the Mechanical Filters are installed. The additional water required can be found from the Sathyamurthi Sagar in years of normal rainfall but it must be remembered that this Reservoir was intended to serve more as a reserve source of supply in drought years than as a source of regular additional supply. The maximum supply that was assured from the combined capacity of the Red Hills lake and the Sathyamurthi Sagar at Poondi in normal years is limited to 30 million gallons per day. Any quantity of water drawn from the Sathyamurthi Sagar in excess of this limit for increasing the daily supply to the city will seriously affect the usefulness of this Reservoir as a reserve in times of need. Additional sources of supply have therefore to be found early. Otherwise the position will revert to what it was before the construction of the Sathyamurthi Sagar and in the event of a drought, it will be necessary to impose restriction on the city supply even in the first year of drought. Before the Andhra State was separated from Madras, there was a proposal under the First Five year plan to bring water from the Krishna River upto the Madras city and also further south through the Krishna-Pennar scheme which was then under consideration. But unfortunately there was some difficulty about the exact location of the dam to be constructed on the Krishna river

as there are two or three sites and different people were pleading for different sites. It is now understood that a decision has been taken to locate the dam at Nandikonda and water from Krishna river will be brought upto the borders of the Andhra State. Madras city being within 30 miles of the Andhra State border, it would be quite possible with the help of the Andhra Government to get a certain amount of this water for the use of the Madras city. From the recent statements made by persons of authority in the Andhra State it is understood that at present only about 6 per cent of waters of the Krishna river are harnessed and used for irrigation purposes and the balance goes into the sea. It appears that it may be quite possible by mutual agreement between the Madras and Andhra States and by contributing a certain portion of the cost of the scheme to get Krishna waters for the use of Madras city. As Krishna river has its origin in the western ghats it has got a perennial supply and would come in handy for providing an assured supply of water for the city.

Very recently between 1947 and 1952 there was a successive failure of the north-east monsoon for 5 years when the city's water supply was placed in a precarious position. To avoid such a situation in future it is hoped that the Central Government and the Planning Commission would agree to such a proposal to bring Krishna water to the Madras city. There was a proposal for utilising the flood waters of the Palar River but this was not considered feasible.

There are now certain other proposals under consideration the details of which are given elsewhere. Augmentation of the source of supply in one form or other has to be found early, as the water supply to the city, with its increasing population will ever remain in a precarious position, if a satisfactory solution of this problem is not found.

2. Filtration.

The quality of the water supplied to the city needs urgent improvement. For this purpose the existing slow sand filters need to be completely replaced with Rapid Mechanical Filters early.

3. Pumping.

The existing Steam pumps at the Kilpauk Water Works have served for more than 40 years and are very worn out and they need urgent replacement with electrical pumping units.

4. Extension of Red Hills supply and improvement of protected water supply to the extended areas of the city.

About 25 square miles of the outlying areas were added to the City in 1946. Except Saidapet and Sembiam, the other areas had

no protected water supply system. Even in Saidapet and Sembiam only a limited supply is given from local Infiltration Galleries and house connections are restricted. After the inclusion of the outlying areas within the city limits, there has been strong public agitation for extension of protected water supply system to these places also and the Corporation has to meet the just demands of the rate payers of these areas.

5. Re-designing of the Distribution System on a Zonal Basis.

Owing to the rapid development of the city, the existing distribution system has been taxed to the full, and as a result the pressures at the tail-ends of the city are considerably reduced and most of the houses in these localities and particularly in high level areas get only a deficient supply, while the areas close to the Kilpauk Water Works get a good supply. The unequal distribution of water obtaining in different areas in the city needs to be remedied urgently.

6. Waste Water Detection Scheme.

The distribution system of the city consists of nearly 500 miles of water mains of different sizes besides 62,000 house connections. The street mains and service mains are mainly underground. Some of them were laid several decades back. It is quite possible that there are underground leaks in some of these mains and services. Further there is wastage through public fountains also. A systematic and periodical check of the water mains and services is necessary to ensure that no preventable wastage occurs in them.

7. Metering of further house services, remodelling of Public Fountains etc. are some of the other items which require urgent attention.

Hitherto it was the State Government that has been providing the Corporation with the required loans and grants for carrying out its programme of water supply capital works. The Corporation has also been permitted by the Government in recent years to raise loans in the open market in certain cases. In spite of all this some of the water supply schemes had to be deferred for want of funds. It was at this juncture that the Government of India offered financial assistance to the State Government and through them to the Madras Corporation for the improvement of water supply and drainage schemes under the 1st and 2nd five-year plan. The Madras Corporation took advantage of this and immediately submitted proposals to the State Government for inclusion of certain schemes in the 1st five-year plan and a few others under the 2nd five-year plan.

The details of the schemes, included in the 1st and 2nd five-year plans are as noted below :—

1. (*a*) **Erection of falling shutters over the Tamarappakkam Anicut, widening of the existing channel etc.**

During heavy rains in the monsoon period, when the Kortalayar river is in full floods a huge quantity of water sometimes surplusses over the Tamarappakkam Anicut and goes to waste. It is now proposed to provide falling shutters above the crest of the Anicut and improve the regulators so as to divert more water into the Upper Supply channel leading to the Cholavaram Lake. The Upper Supply channel will also be widened to increase its carrying capacity. The estimated cost of this scheme is Rs. 21.00 lakhs.

(*b*) The utilization of the flood waters of the Arniyar river for supplementing the supply to the city has also been under consideration for some time. The Government have now taken up the construction of a Dam and Reservoir at the Upper Reaches of this River. A part of the water which will be stored in this reservoir may be available for city supply in lean years but the manner of conveying the water to the city and the financial implications of the proposal have to be worked out.

2. Improvements to the Filters—Construction of additional filtered water tanks, balancing tank, installation of Diesel Generator and construction of quarters for the staff at Kilpauk Water Works.

(*a*) **Improvement to the Filters** :—As stated in the previous Chapter, arrangements are being made for installing Rapid Mechanical Filters of 10 million gallons per day capacity at the Kilpauk Water Works. When this plant is installed, it will be possible to filter and supply to the city an additional 10 million gallons of water per day but the quality of the water which will be supplied to the city will not be very much different from that of the present supply as the water drawn from the Mechanical filters will have to be mixed with the filtered water of indifferent quality emerging from the slow sand filters.

It has been established that the existing slow sand filters are unsuited for satisfactorily filtering the Red Hills water. Besides, they have served for over 40 years and cannot be expected to last much longer. They need to be replaced early. It is therefore proposed to install Rapid Mechanical Filters to filter another 30 million gallons per day and scrap the existing slow sand filters altogether so that the whole of the water required for city supply may be filtered by a single process by Rapid Mechanical Filters providing for a maximum output of 40 million gallons per day. The estimated cost of this further scheme is Rs. 70.00 lakhs.

(*b*) **Construction of two additional Underground filtered water tanks.—**

There are at present 4 filtered water tanks at the Kilpauk Water Works with a total capacity of 6.2 million gallons per day for storing the water filtered by the existing slow sand filters before the water is pumped into the distribution system. Two more underground filtered water tanks each of 2.08 million gallons capacity are now under construction for storing the water that will be filtered by the Rapid Mechanical Filters of 10 million gallons per day capacity which will be installed shortly. The contract for this work which is estimated at Rs. 10.67 lakhs has been awarded to Messrs. McKenzies Ltd. The works have been started in May 1955 and are now progressing satisfactorily. It will be necessary to construct at least two more filter water tanks, when the existing Slow Sand Filters, which filter about 23 million gallons per day, are replaced by Rapid Mechanical filters of 30 million gallons per day capacity as per proposals contemplated under the 2nd Five-Year Plan.

Unless arrangements are made for storing adequate quantity of filtered water, it will not be possible to meet the city demand of nearly 2 million gallons per hour during the peak demand hours. Further the filtered water tanks should be of sufficient capacity to receive the output from the filters. Otherwise the surplus filtered water will back up into the filtered water conduit and retard the flow of filtered water from the filters. The estimated cost of the construction of two more filtered water tanks similar to the two tanks now under construction comes to Rs. 13.00 lakhs and when these are completed, they can provide for an ultimate storage capacity of 14.34 million gallons.

(*c*) **Replacement of the existing steam pumping sets by electrical units and diesel generators.—**

As stated already, there are at present 3 steam pumping plants and 3 electrical pumping units at the Kilpauk Water Works for pumping the filtered water into the distribution system. Most of the pumping is now done by the electrical units supplemented by the steam engines during the peak demand hours.

The Steam pumping sets installed in 1914 have served for over 40 years. They have practically outlived their usefulness and are very worn out. Between 1942 and 1951 a sum of over Rs. 2.75 lakhs had to be spent for overhauling two of these steam engines. It will be very uneconomical to maintain and run these worn out steam engines any longer. Further, it will not be safe to rely on

these steam pumping sets in their worn out condition for ensuring an uninterrupted supply to the city. They require to be replaced very early.

A scheme costing Rs. 13.90 lakhs has been drawn up for installing 3 more electrical units of 0.8 million gallons per hour capacity to do the supplemental pumping now being done by the steam engines of 0.75 million gallons per hour capacity. The scheme also provides for the installation of two standby diesel driven alternators each capable of developing 625 Kilowatts. In the event of failure of electric supply or other causes such as the power cuts imposed by the Madras Electricity System at certain stated hours the Diesel unit would supply the necessary electricity to run the electrical pumping units. This scheme has been approved by the Corporation Council and is now awaiting sanction of Government.

(*d*) **Construction of an additional balancing Tank at the Water Works.—**

The existing elevated tank at the Kilpauk Water Works which acts as a balancing tank between the pumps and the distribution system is of 1½ million gallons capacity. But when the present daily supply of 26 to 27 million gallons is increased to 30 to 35 million gallons as is proposed to be done after the installation of the Rapid Mechanical Filters it will be necessary to increase the storage capacity of the balancing tank. It is proposed to construct an additional elevated tank of 3 million gallons capacity with 2 different compartments to facilitate the cleaning of each compartment periodically without putting the balancing tank out of commission. The estimated cost of such a tank is Rs. 25 lakhs.

(*e*) **Construction of Staff Quarters :—**

In the interest of the City Water Supply it is found advantageous to house the staff working at the Kilpauk Water Works in the water works compound itself, so that their services may be readily available in the event of any breakdown of the pumpsets, or other emergencies. At present only a few of them are housed in the Kilpauk Water Works compound and with a view to house the rest of the existing staff and the additional staff that will be required to run the Mechanical Filters it is proposed to construct suitable quarters for the staff at the Water Works. Acquisition proceedings are under way for acquiring the required additional land adjoining the Kilpauk Water Works and detailed proposals for construction of staff quarters will be submitted for sanction shortly.

Redesigning of the Distribution System on a Zonal Basis.—

The existing Distribution was designed and executed by Mr. Madeley in 1914. In designing the Water Supply System, Mr. Madeley divided the city into seven zones each of which was to be fed by a principal main and several sub-mains of varying sizes. The sizes and lengths of these mains were determined with regard to the following factors.

1. Anticipated population of each zone in 1961.

2. Quantity of water to be supplied per head per day which was fixed at 25 gallons.

3. Minimum head to be maintained in different mains at Tail ends. This was assumed as 20 feet.

According to Mr. Madeley's estimate the population of the city which was 5,17,335 in 1911 was expected to go up to 6,60,000 in 1961 but the city developed far more rapidly than was anticipated by Mr. Madeley and the population of the city went above 6,60,000 even as early as 1940. The census figure for 1941 was 7.70 lakhs and it is now nearly 15 lakhs. While Mr. Madeley estimated that 247 miles of water mains will be needed for the city in 1961, we have had to lay nearly 500 miles of street mains as on this date to meet the growing needs of the city. The daily supply also went above the assumed maximum of 16.50 million gallons and reached a figure of 25 million gallons per day even in 1935. The increased draw off from the Trunk Mains and sub-mains resulted in poor residual pressures at the tail ends of the distribution system particularly in the high level areas and there is not even 2 or 3 feet pressure at these places.

Further the city began to expand in certain directions contrary to previous expectations and the Trunk Mains feeding these areas became ineffective in providing the minimum supply required. As a temporary measure Booster Pumps were installed to improve the supply to these areas during peak demand hours. But with a view to remedy the unequal distribution of water to the different areas in the city and to improve the distribution system in general, a comprehensive scheme is now under preparation. This scheme contemplates dividing the city into 9 convenient zones, each of which will be fed by an independent trunk main from the Kilpauk Water Works. The sizes and lengths of these mains will be determined with reference to the geographical position of each zone, the concentration of population in each of these areas, the scope for further development and other relevant factors. Each zone will in turn be sub-divided into several areas and the supply to each of these areas will be controlled by a meter and regulated

according to the population of the area. By this method it is expected that the distribution of water to the different areas would be done on an equitable basis and the poor pressure now obtaining at certain areas avoided. Detailed proposals are being worked out by a special staff appointed for the purpose. It will take some time before a comprehensive scheme is prepared.

As the water supply to Tondiarpet and adjacent areas in North Madras is very defective and need urgent attention, an outline scheme for Rs. 43.90 lakhs for laying a 42″ Trunk main from the Kilpauk Shaft and connecting it to the distribution system at the Old Jail Street for serving Tondiarpet area comprising of 1 to 5 divisions and part of Division 7 has been prepared and forwarded to the Chief Engineer to Government for approval. This will form part of the comprehensive scheme of zonal distribution system which is now under preparation.

City Distribution System Improvement :—

The following schemes for improvement of the city distribution system are under progress.

1. **Scheme for Rs. 15.29 lakhs for laying new mains and renewing old mains in the city.**

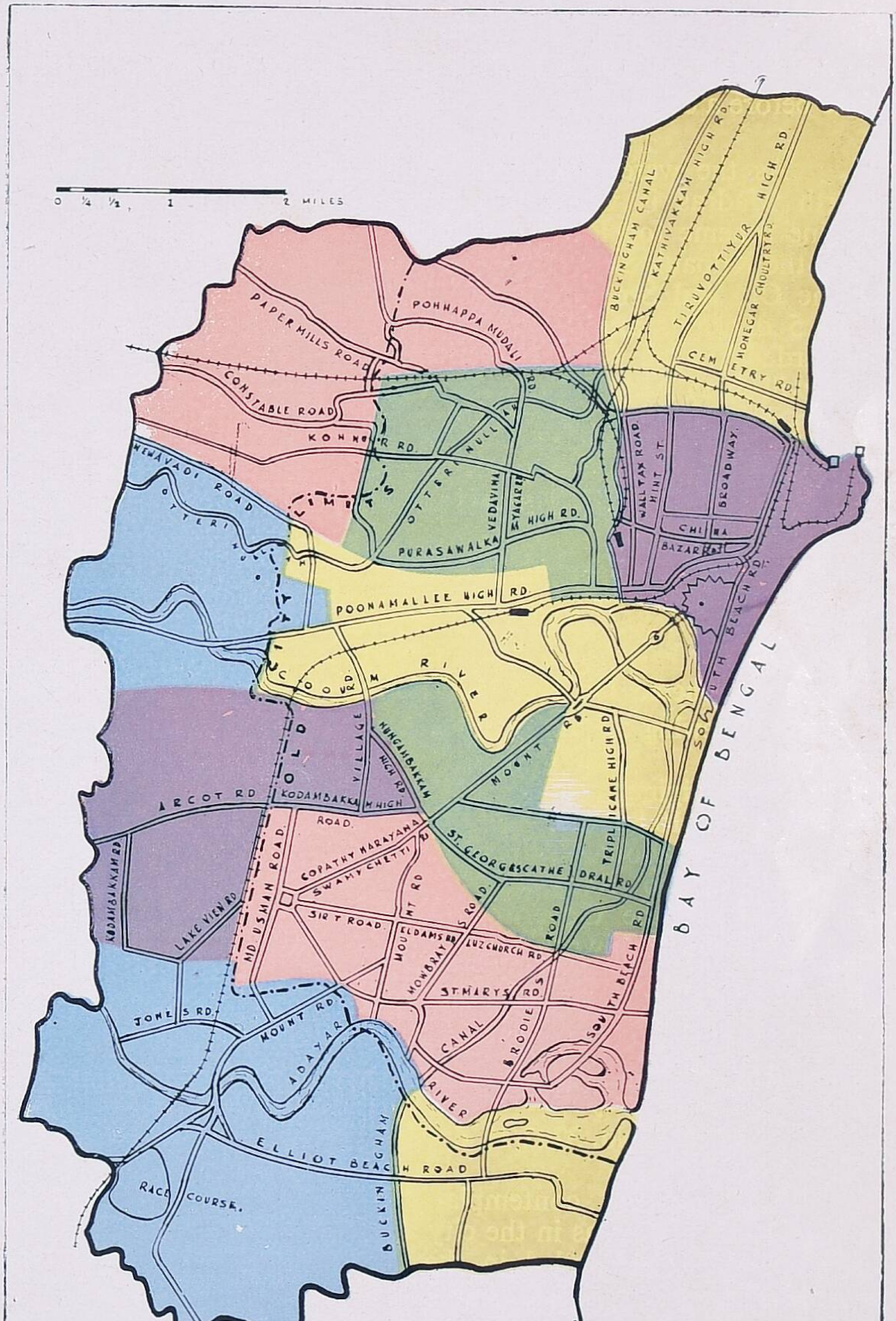
The original estimated cost of this work as sanctioned in 1940 was Rs. 10.85 lakhs but owing to the increase in the cost of materials and labour, during the 2nd World War the estimate had to be revised to Rs. 15.29 lakhs. The revised estimate was sanctioned by the Government in G.O. No. 1319, P.H., dated 13—4—1951. The works included in this scheme were started in 1940 and the scheme will be completed by the end of March 1956.

2. **Further Improvements to the City Water Supply distribution system-scheme for Rs. 4.76 lakhs sanctioned in G.O. No. 3292/H, dated 20—9—50.**

This scheme contemplates the laying of water mains in newly developed areas in the city and in such of those streets in the city as were not included in the previous scheme of distribution system improvement. An expenditure of nearly Rs. 3 lakhs has been incurred on this scheme upto date and further works are in rapid progress.

REDESIGN OF CITY DISTRIBUTION SYSTEM ON ZONAL BASIS

PROPOSED ZONES



3. Extension of water supply distribution system in Alagappa-nagar layout and Aminjikarai area scheme for Rs. 2.77 lakhs sanctioned in G.O. No. 1305-H, dated 14—4—50.

Provision is made in this scheme for extending the benefit of protected water supply to a portion of the extended areas of the city (viz.)—Aminjikarai. Works to the value of Rs. 1.35 lakhs have been executed so far under the scheme.

4. Provision of water supply to Gandhinagar and adjacent areas. Estimate for Rs. 4.36 lakhs sanctioned in G.O. No. 1312/H, dated 14—4—50.

Gandhinagar is one of the colonies recently formed by the Madras House Construction Co-Operative Society in the extended areas of the city adjoining Adyar. Another colony known as Kasturba Nagar has been formed as an extension of Gandhinagar. When a proposal for supplying Red Hills water to this colony was made, the Government desired that an independent source may be found for supplying water to this area instead of extending the Red Hills supply.

An estimate for Rs. 4.36 lakhs for sinking two large wells in the area with a overhead tank, necessary pumping main and distribution main was sanctioned by the Corporation Council and Government. The estimate also included provision for supplying Red Hills water to this colony from the Mandavalli Booster Tank. Pending the provision of an independent source, a 9″ main was accordingly laid from the Mandavalli Booster Tank and Red Hills water was arranged to be supplied to Gandhinagar as a temporary measure.

Two large masonry wells, one of 20′ diameter and another of 10′ diameter have since been sunk in Urur Village, Damodarapuram. An R.C. Overhead Tank of 60,000 gallons capacity has also been built. An 8″ pumping main with necessary pumping sets (electrically driven) have also been provided. The average yield from these two wells is about 1,00,000 gallons per day against the full requirements of 1,60,000 gallons per day. It is proposed to sink one or two more wells to provide the additional supply required and necessary investigations are being made to find out the quality of the water and the potentialities of the source. A revised estimate for Rs. 7.62 lakhs making provision for acquiring additional land for sinking one more well installing additional pumping set etc. was prepared and sanctioned by the Council on 2—2—1954 but the Government have returned the estimate for revision. The matter is now receiving attention.

5. Further scheme of city distribution system improvement in Mylapore Housing Scheme area and other newly developed layouts in the City.

An estimate for Rs. 3.89 lakhs for providing water supply to Rajah Annamalaipuram, Mylapore and other developed layouts in the city has been sanctioned by the Council on 22—12—1953 and by Government in G.O. No. Ms. 2663-H, dated 25—9—1954. Under the scheme it is proposed to lay 4″ street mains to a length of 64,968 feet besides 3,600 ft. of 5″ to 8″ size. This is one of the items of work included in the 1st five year plan. More than 75% of the work has been completed.

6. Estimate for Rs. 2.45 lakhs for laying water mains in the extended areas and in some parts of the city where pressure is adequate.

The above scheme has been sanctioned by the Corporation Council and Government and work is under progress.

7. Extension of Red Hills water supply to Saidapet. Laying 18″ feeder main from Mount Road junction of Cenetoph Road.

Water Supply to Saidapet, portions of West Mambalam and Guindy which formed part of the Municipality of Saidapet and which were later on added to the Madras City in 1946 is provided for an infiltration gallery situated at Ekattu Thangal near Saidapet. The maximum supply that could be tapped from the infiltration gallery is about 2 lakhs gallons. In years of poor rainfall the yield is still less. The average supply made to the residents of this locality from this source does not work out to more than 3 gallons per head per day. As there is no possibility of increasing the yield from this source or of supplementing it by tapping new underground sources in the vicinity of Saidapet it has been proposed to divert about 3½ lakhs gallons of Red Hills Water per day from the distribution system of the city by laying an 18″ branch main from the Trunk Main No. 8 at Mount Road junction of Cenetoph Road to supplement the supply from Ekattu Thangal. When this branch main is laid, water supply will improve in areas adjoining Mount Road and part of T.Nagar upto the Old City Limits and also in portions of Saidapet where the supply is now defective. Detailed plans and estimates amounting to Rs. 3.48 lakhs have been approved by the Council on 18—5—1954 and by Government in G.O. No. Ms. 1095-H, dated 22—3—1955. This is also one of the schemes included in the first five year plan. Orders for the supply of the

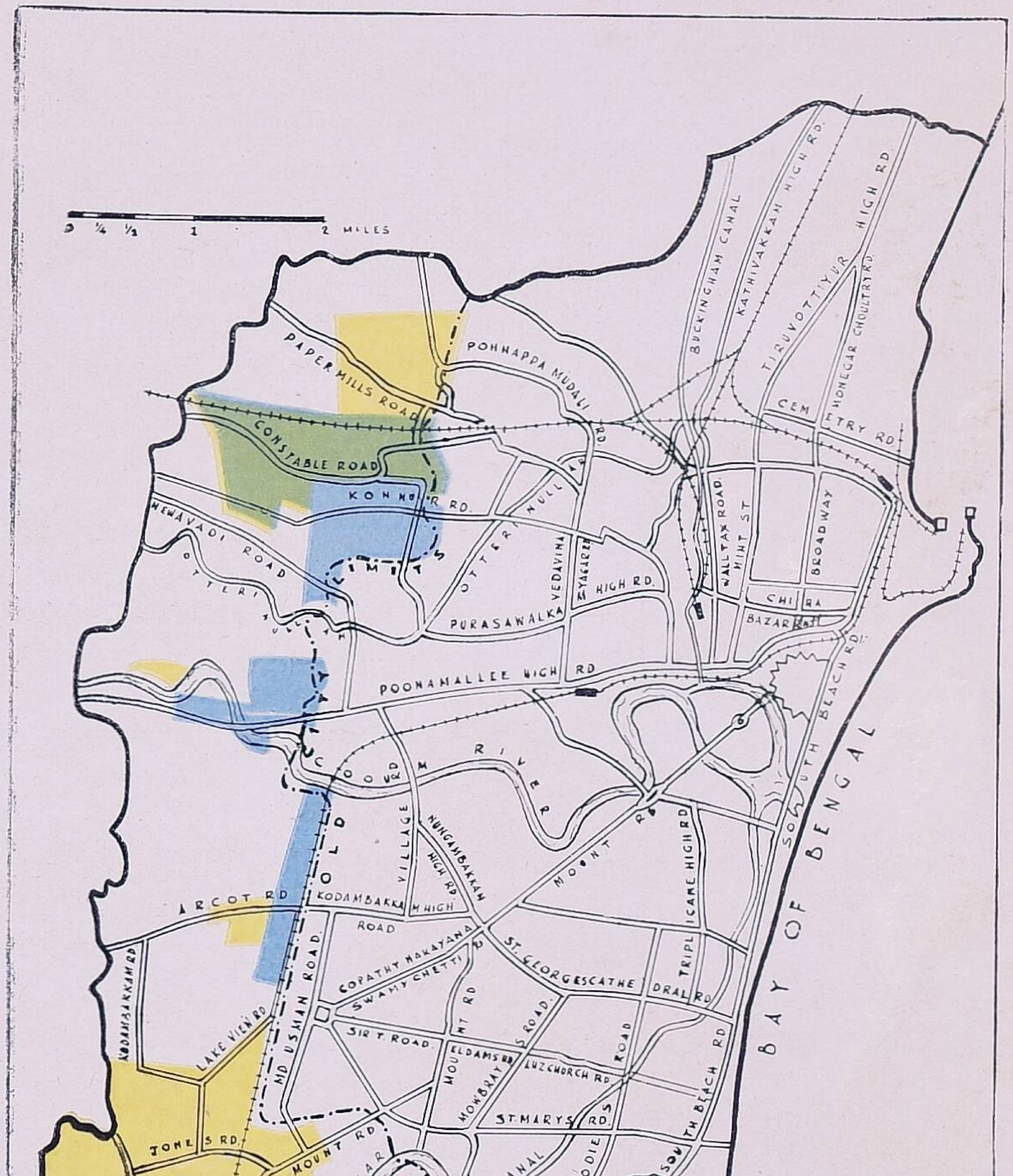
MADRAS CITY

WATER SUPPLY TO EXTENDED AREAS

AREAS PROVIDED WITH INDEPENDENT SOURCES OF WATER SUPPLY

AREAS TO WHICH RED HILLS WATER SUPPLY HAS BEEN EXTENDED

AREAS HAVING THEIR OWN WATER SUPPLY



required cast iron pipes and specials have been placed with the accepted tenderer and work will be taken up for execution as soon as the pipes are received.

8. Scheme for Rs. 2.49 lakhs for expanding the Saidapet Distribution System.

There are at present no water mains in many of the streets in Saidapet, West Mambalam and Guindy. The total length of streets still remaining to be provided with water mains in this area is nearly 90,000 feet. In the present estimate provision is made for laying 37,800 feet of 4″ mains which will fit in with any comprehensive scheme of redesigning the distribution system of the city as a whole. The estimate for Rs. 2.49 lakhs has been approved by the Corporation Council and Government and work will be taken up shortly after the pipes are secured and the 18″ branch main from Mount Road is laid to supplement the supply from the infiltration gallery at Ekattu Thangal.

9. Provision of Water Supply to Nungambakkam Town Planning Area.

An estimate for Rs. 67,200 for laying 4″ and 6″ mains in this area was sanctioned by the Corporation Council on 10—10—1950 but the Government desired that water mains may be provided for the time being only in those streets where residential buildings have been constructed and accordingly the estimate was revised to Rs 28,000/- restricting the work to only a few of the streets which have fully developed. This was sanctioned by the Taxation and Finance Committee on 2—9—53 and by Government in G.O. Ms. No. 894-H, dated 7—4—54. This scheme has been put into execution and about 4,516 feet of mains have been laid so far.

10. Remodelling and reconstructing of Public Fountains—Estimate for Rs. 6.00 lakhs.

There are about 80,000 residential houses in the city. Houses with an annual assessment of less than Rs. 60/- are not eligible for water connection. So far about 62,000 houses have been given private water service connections. For meeting the needs of the people who do not have water taps in their houses and also of the floating population in the city, the Corporation has provided about 4,000 street taps or public fountains. These are mostly situated in unimportant streets and by-lanes and also in slum areas where individual water connections are not available and the public need common taps for their daily requirements of water. These are widely used by the people and there is a great demand for the

erection of more public fountains to meet the needs of the poorer classes of people in the city. Many of the existing Public Fountains also are not in a good condition.

A scheme for remodelling and reconstructing 1,100 numbers of Public fountains *in the first instance* at an estimated cost of Rs. 1.96 lakhs has been approved by the Corporation Council and the Government under the 1st five year plan and the work is under rapid progress. This scheme has to be further continued and necessary recommendations have been made under the 2nd five year plan.

11. Metering of House Services—Estimate for Rs. 10.00 lakhs.

There are about 62,000 house services in the city. Of these only 4,600 services are metered. Many of these meters are very old and worn out and do not function properly.

As many as 1,500 meters have been withdrawn from service and sent to the workshop for repairs. It is probable that many of these are declared unserviceable. New meters have to be purchased for replacing the old meters in the larger interests of the Corporation. In some cases meter fixing charges have been collected from the owners but no meters have been fixed yet for want of new meters.

If proper control of supply through efficient metering is maintained, it will prevent a considerable amount of wastage that now occurs through negligence or carelessness on the part of the public. The Corporation could not however find the funds required for purchasing large number of meters from its limited revenues. It has therefore been proposed to obtain loans for purchasing and fixing the meters wherever necessary.

A scheme costing Rs. 2 lakhs for purchasing and fixing 1280 meters of various sizes in the first instance has been approved by the Corporation Council and the Government from loans provided by the Central Govt. under the first five year plan. Meters have been purchased and work commenced. A further programme of purchasing and fixing meters has been recommended for inclusion in the second five year plan.

12. Sembiam Water Supply—Supplementing of :

Sembiam area which was newly added to the city in 1946, is supplied with water from an infiltration gallery located in the same area but the supply from this source is very meagre. To supple-

ment this supply it is now proposed to divert 5 lakhs gallons of Red Hills water from the Kilpauk shaft by laying a separate 14″ feeder main and connecting it to the overhead Tank at Sembiam. Necessary plans and estimates have been sanctioned by the Corporation Council and the Government and the required pipes have also been ordered. The work will shortly be taken up so that the supply to Sembiam and part of Perambur may be improved.

Two statements (1) showing the particulars of water supply scheme works sanctioned under the first Five Year Plan and (2) showing particulars of water supply scheme works recommended for inclusion in the second five year plan are appended. It will be seen from the statements that the total value of the schemes included in the first five year plan comes to Rs. 98.00 lakhs. Of this, works to the value of Rs. 41.50 lakhs is expected to be completed before the end of March 1956 (i.e.) the first five year Plan period. The works remaining to be done to the value of Rs. 56.50 lakhs will be carried over to the second five year plan.

In addition several new works to the value of Rs. 185.00 lakhs have been recommended by the State Government for inclusion in the second five year plan. These are all very important and urgent works in which the entire 16 lakhs citizens of Madras City are interested and it is hoped that the Government of India would approve of all the items of works and provide the necessary funds.

FACTS AT A GLANCE

SATYAMURTHI SAGAR :

Completed in	1944
Capacity at full tank level ...	2,500 mill. c.ft.
Water spread at full reservoir level.	12½ sq. miles.
Total catchment area	787 sq. miles.
Full reservoir level above M.S.L.	+ 137.50
Lowest drawable level	+ 105.00
Distance from Madras	37 miles.

TAMARAPAKKAM ANICUT :

Length of anicut	626 ft.
Height of anicut	6 ft.
Width at crest level	6 ft.
Crest level	+ 72.40
Bed level	+ 66.40
Distance from Madras	17 miles.

UPPER SUPPLY CHANNEL :

Head sluice.

15 Vents	5′—0″ × 5′—7″
Sill level	+ 66.40

UPPER SUPPLY CHANNEL :

	miles.	chains.
Length of channel	8	14
Width at bottom on average ...	45 ft.	
Side slopes	1 : 1	
Depth at full supply	7 feet.	
Carrying capacity	1220 Cusecs.	

CHOLAVARAM LAKE :

Capacity at full tank level ...	525 mill. c.ft.
Water spread at full tank level ...	2 sq. miles.
Catchment area	11 sq. miles.
Full tank level above M.S.L. ...	+ 60.12
Lowest drawable level	+ 46.64
Distance from Madras	14 miles.

LOWER SUPPLY CHANNEL :

Head sluice.

9 Vents	3′—0″ × 4′—0″
Sill level	+ 46.64

LOWER SUPPLY CHANNEL :

	Miles.	Chains.
Length of channel	2	50
Width at the bottom		30 ft.
Side slopes		$1\frac{1}{2}$: 1
Depth at full supply		7 ft.
Carrying capacity at F.S.L. ...		900 Cusecs.

RED HILLS LAKE :

Capacity at full tank level ...	2185 mill.c.ft.
Water spread at full tank level ...	7 sq. miles.
Catchment area	23 sq. miles.
Full tank level above M.S.L. ...	+ 46.17
Lowest drawable level	+ 20.00
Distance from Madras	10 miles.

MASONRY CONDUIT :

Old conduit	5′—0″ × 4′—3″
Bed fall	1 foot per mile.
Carrying capacity	23 mill. gallns. a day.
New conduit	6′—6″ × 4′—3″
Bed fall	1 foot per mile.
Carrying capacity	32 mill. glns. a day.

FILTER BEDS :

Slow sand Filters	14 Nos. 200′ × 100′ 3 Nos. 200′ × 133′

FILTERED WATER TANKS :

Filtered water tanks	3 Nos. 1.4 mill. glns. each. 1 No. 2 mill. glns. 2 Nos. 2.08 mill. glns. each (under constn.)

PUMPSETS :

Electric pumpsets	3 Nos. of 1.2 mill. glns, per hour against a head of 80 feet.
Steam Engine pumpsets	3 Nos. of 0.8 mill. glns. per hour against a head of 80′.

PUMPING MAINS :

48″ diameter mild steel pumping main	1
48″ Cast Iron pumping main ...	1

DISTRIBUTION MAINS :

Cast Iron Trunk mains of sizes varying from 42″ to 14″ ...	8 Nos.
Length of Pumping mains, trunk mains and sub-mains 48″—9″ ...	42.21 miles.
Length of distribution mains 8″-4″.	435.41 miles.

Statement showing the total expenditure on Water Supply Capital Works upto end of March 1955.

Particulars of Work.	*Cost.* Rs.
'Old Works' in existence prior to 1914 comprising of Valve House at Red Hills, Open earthen supply channel leading to the City and Distribution System	23,00,000.
'New Works' opened on 17th December 1914 viz., In-take Tower at Red Hills, Underground Conduit, Slow Sand Filters, Filtered Water Tanks, Pumps, Elevated Tank, Pumping Main, alterations and extensions to the Distribution System including the 3 Filters and one Filtered Water Tank added in 1923.	66,00,000.
Further improvements and extensions to the Distribution System	45,27,890.
Improvements to Red Hills Lake (Corporation's contribution)	48,000.
Waste Detection Meters and Bulk Meters ...	1,50,000.
Installation of Booster Pumps and Underground Storage Tanks	1,20,000.
Installation of additional Pumping Units at Kilpauk	5,04,000.
Construction of " Satyamurthi Sagar "	65,95,806.
Water Supply to Theagaroya Nagar	3,95,467.
Water Supply to City Extensions	90,000.
Construction of Second Conduit	50,83,857.
Separate Trunk Main for South Madras ...	37,20,166.
Duplication of Pumping Main from Kilpauk Pumping Station to Shaft	6,21,284.
Emergency Water Supply Works carried out during the Drought years 1950, 1951 and 1952	19,12,898.
Total Rs. ...	326,69,368.

CORPORATION OF MADRAS

WATER WORKS DEPARTMENT

Statement showing the water supply schemes proposed for execution under the first five-year plan.

	Description of water supply schemes proposed for execution under the First Five Year Plan.	*Estimated Cost Rs. in lakhs.*	*Anticipated expenditure in 1st five year plan period.*
1.	Installation of Rapid Mechanical filters of 10 m.g. capacity at Kilpauk Water Works—G.O. No. 3019-H/8—11—54. ...	25.00	5.50
2.	Construction of two additional filtered water tanks at Kilpauk Water Works G.O. No. 1352-H/18—5—54 ...	10.67	8.00
3.	Diesel Standby Unit for Kilpauk Pumping Station. Estimate sanctioned by the council. ...	13.90	5.00
4.	Further Scheme of Distribution System in new developed layouts in South Madras G.O. No. 2663-H/25—9—54 ...	3.89	3.90
5.	Providing Feeder main to Saidapet area to feed Government Colony, etc., awaiting Govt. sanction. ...	3.48	2.50
6.	Further scheme of Distribution System to Mambalam Town Planning Area. Sanctioned by Council on 31—12—54.	1.29	0.75
7.	Metering House Service connections. Sanctioned by Council on 31—12—54.	10.00	1.50
8.	Remodelling of Public Fountains in the city. Sanctioned by Council on 31—12—54	6.00	1.50
9.	**Water Supply to Extended Areas.** a. Aminjikarai ... b. Ayanavaram ... c. Kodambakkam ... d. West Mambalam ... e. Saidapet ... f. Sembiam ...	11.06	5.00
10.	Acquisition of land west of Kilpauk water works	4.65	2.00
		Total Rs.	35.65 lakhs